THE STUDENT,

AND

INTELLECTUAL OBSERVER.

MARCH, 1868.

WOMANKIND:

IN ALL AGES OF WESTERN EUROPE.

BY THOMAS WRIGHT, F.S.A.

(With a Coloured Plate.)

CHAPTER I.—(*Continued.*)

WOMAN IN GAUL AND BRITAIN UNDER THE CELT AND ROMAN.

We give in our coloured engraving, a copy of the Pompeian toilette-scene alluded to in the preceding paper. As we find not unfrequently in these wall-paintings, the drawing is not always correct. The lady to the right, who forms the most prominent figure in the picture, is seated in a somewhat anomalous manner, upon some seat which is not clearly visible, but it was probably intended for one of those chairs which are not unfrequently found in the Roman sculptures and pictures, one side of which only is imperfectly apparent between the lady and her *coiffeuse*. The second lady, too, is rather awkwardly seated. But that which is still more worthy of remark is the uniformity in the colour of the hair—all, ladies and servants, have hair of the same shade of yellow. Yellow hair, we know, was the favourite colour among the Romans. Pyrrha, the admired of Horace, was yellow-haired—

> "Cui flavam religas comam,
> Simplex munditiis?"
> Horat., "Carm., i. 6.

The verb *religas* is explained in the gloss by *nodo colligis, i.e.*, bind up in a knot, which is just what the maid is doing in our picture, and which was the usual *coiffure* of the Roman ladies. Catullus ("Carm." lxvi., line 62) speaks of the *flavus vertex*, or yellow crown, of his Berenice. Propertius, among the beauties of his Cynthia, says that her hair was yellow and her hands long—

> "Fulva coma est, longæque manus."
> Propert., "Eleg.," lib. ii. 2.

And Tibullus, when protesting against the supposition that his affections had been gained by magical incantations, says that his mistress fascinated him, not by the operation of such charms, but by the beauty of her face, the elegance of her limbs, and by her yellow hair—

> "Non facit hoc verbis; facie tenerisque lacertis
> Devovet et flavis nostra puella comis."
> Tibull., "Eleg.," i. 5, line 43.

So in Virgil, the hair of Dido was yellow; *flaventesque abscissa comas* ("Æn.," iv. 590), and

> "Nondum illi flavum Proserpina vertice crinem
> Abstulerat."
> "Æn.," iv. 698.

As well as that of Lavinia—

> "Filia prima manu flavos Lavinia crines
> Et roseas laniata genas."
> "Æn.," xii. 605.

Of course to produce this uniformity of colour, as seen in the Pompeian painting, artificial means must have been employed, either dye or powder, and we know that among the wealthy and extravagant it was not unusual to powder the hair with gold-dust. We shall not proceed far in the history of Womankind before we meet again with this practice of artificially colouring the hair.

We know very little of the dress of our Celtic forefathers, whether Gauls or Britons. If we believe some of the ancient writers, the British costume, as well as that of the Gauls—we cannot correctly call it dress—was simply nakedness painted blue, and by way of further ornament they had recourse to the practice of tattooing. Cæsar is the first writer from whom we derive this information, and he adds that the substance with which they painted, or rather dyed, their bodies, was derived from the plant woad. It is

repeated by other Roman writers, and was so generally believed, that when the poet Martial speaks of a lady of British descent, he talks of her ancestors as "azure-coloured Britons":—

> "Claudia cæruleis cum sit Rufina Britannis
> Edita, quam Latiæ pectora plebis habet!"
> Martial, "Ep.," lib. xi. ep. 53.

This story has been so generally credited, that that worthy old historian, John Speed, in his folio "History of Britaine," has treated us with a carefully-executed picture of a British lady, in all her nudity, covered with tattooing of the most pictorial character. Yet I would venture to doubt if this were ever more than a fable.

Others of these hearsay stories of the manners and condition of people in distant countries have been handed down to us by the ancient writers, most of them probably no more worthy of credit than the one just told. Cæsar informs us that among the Britons in the interior of the island, by whom we are to understand the original Celtic population, the sentiment of domesticity was so imperfect, that ten or twelve men, generally belonging to the same family, had their wives in common, the children being considered as belonging severally to the man who first married their mother. The well-known stories of two British queens, Boadicea of the Iceni, and Cartismandua of the Brigantes, seem hardly consistent with a state of society such as indicated by these tales, either in the maritime states or in the interior of the island. However, at the time of Cæsar's invasion, social life among the Gauls was in a very low state of development, and had still hardly emerged from its patriarchal condition. He tells us that the husbands had the power of life and death over their wives and children, and it seems to have been generally assumed that the wife had no great love for her lord. When a man of importance happened to die suddenly, or in an extraordinary manner, it was taken for granted that his wife or wives were the cause of his death, and she or they were immediately seized and subjected to torture. If there appeared the slightest ground for suspicion, the unfortunate victims were committed to still greater torments, and finally burnt to death. An anecdote of Gaulish life is preserved in an epigram in the Greek "Anthology,"* which would seem to show that, at least in some parts of Gaul, it was taken as a general principle that a woman's fidelity to her husband was always to be suspected. Among the

* "Anthologia," lib. i. c. 43, ep. 1.

Belgic tribes the deity of the Rhine (for in those times every river had its god), was believed to pay especial attention to the conduct of the Belgian wives. In this belief the father took his new born child to the river, placed it upon his spacious buckler of wood, and launched it on the water. If it swam on the surface, the father was satisfied of the legitimacy of his paternity; if it sank, he was equally convinced of the illegitimacy of the child, abandoned it to its fate, and no doubt wreaked his vengeance upon the mother. Cæsar informs us of a custom which prevailed in Gaul in his time, the earlier half of the first century before Christ, which shows a marked advance towards the equality of the sexes. On a man's marriage, whatever sum he received with his wife under the name of dower, he added to it the same sum from his own property, and the whole was kept along with the fruits (*fructus*) as a reserved fund, which belonged to the survivor of the two. The mother, also, had the entire care of the children, until the boys had reached the age at which it was customary to instruct them in the use of arms, and, till that period a father looked upon it as disgraceful to appear publicly in company with his son.

No circumstance in ancient history is more remarkable than the readiness with which the peoples who came under the influence of Rome abanonded their nationality, and became Romans. Roman laws, Roman manners, and, more observable than all, Roman costume, gradually superseded those of the conquered. The two remarkable characteristics of the male costume of the Gauls were the wearing of trousers, or breeches, on the legs, and the practice of carrying their hair long. The first portion of Gaul which was formed into a Roman province was that within the Alps, and therefore nearest to Rome, which, on that account, was usually spoken of as Gallia Cisalpina; but from its early adoption of the Roman dress, it soon received the name of Gallia Togata, or Gaul where the toga was worn. When a second province was established, consisting of the portion of Gaul on the other side of the Alps, and bordering upon the Mediterranean, the inhabitants kept for some time their native costume, and on that account it was called Gallia Braccata, or Gaul where trousers were worn. The Gauls themselves knew this article of dress by a name Latinized into *braccæ*, or *bracæ*; it is remarkable that the same word, with the same meaning, is found also in the Teutonic languages—in Anglo-Saxon it is *brēc*, or *brœc*, the origin, of course, of our English word breeches. As the province became more Roman, the braccæ were abandoned, and the province received the new name of Gallia Narbonensis, from its chief town

Narbona (*Narbonne*). In the same manner, the next Roman province received the title of Gallia Comata, or hairy Gaul, so long as its inhabitants retained their old fashion of wearing their hair long.

It would appear that the trousers were a garment worn equally by the Gauls and the Teutons, and the name was probably one of the words common to both languages from their earliest formation. The Teutons, when they become known to us, also wore their hair long, and probably the costume varied little in the two races. But we are very imperfectly acquainted with that of the men, and we have still less knowledge of that of the female sex. The men, we are told, were very fond of dress, and prided themselves in a great display of personal ornaments, such as collars, bracelets, and rings. They dyed their hair of a bright red colour with a sort of pomatum, which Pliny says was made of tallow and cinders.* How far the Gaulish women imitated their husbands in these fashions we are not informed, but they probably adopted the red hair, and covered themselves with jewels, as far as lay in their power. We find, however, that in the state of society which the Romans included under the title of barbarism, the men are generally more given to display in dress and personal ornaments even than the other sex.

After the establishment of the Roman power in Gaul and Britain, the costume of the Romans in Italy was everywhere adopted. The Romano-Gaulish, as well as the Romano-British, lady, wore the tunic, the stola, and the palla, just as the Roman ladies of Pompeii wore them; and the personal ornaments of females found so plentifully in excavations on Roman sites in Britain and Gaul are all entirely Roman. But our materials for the history of Womankind during this period are very scanty, and are hardly to be looked for among the ancient writers. Yet we have a few interesting materials of another class, which are undoubtedly truthful, and which enable us to contemplate the features and costume of the inhabitants of Gaul and Britain in the earlier part of the Roman period. These are the sculptured monumental stones, which were no doubt intended by the sculptor to present portraits of the individuals he commemorated. Unfortunately, but a small number of them are preserved; and for this reason, and on account of their extreme interest, it seems desirable to give them all. Their importance is increased by the circumstance that, in most of them, the inscription enables us to give the names of the persons delineated, and tell who they were. I may add that the greater part of them have been published by our distinguished

* "Galliarum hoc inventum rutilandis capillis fit ex sebo et cinere." Plin. "Hist. Nat." lib. xxviii. c. 12.

antiquary, my friend Mr. Roach Smith, in his most valuable publication the "Collectanea Antiqua."

The first of these monuments, which was found at Mayence, represents a family of citizens of the Roman city of Moguntiacum.

A FAMILY OF MOGUNTIACUM (*Mayence*).

The head of the family, as we learn by the inscription on the stone, was Blussus, the son of Atusirus, and his profession was that of a navigator (*nauta*)—he was probably concerned in the commerce of the Rhine. His wife, the lady we see, was Menimane, the daughter of Brigio, and behind them stands their son Primus, who raised the monument to their memory, as a token of filial piety. Blussus died at the advanced age of seventy-five, but the lady appears to have been much younger, and probably outlived him many years, for the blank left in the inscription for the insertion of her age when she died has never been filled up. She was evidently a lady possessed of personal attractions, and was fully aware of it, if we may judge by the richness of her dress and personal ornaments. She wears first the tunic, which differs from the ordinary Roman tunic in fitting closely to the arms and bust, and in being furnished with long sleeves, which turn back in cuffs, resembling the modern gauntlet cuffs. It is gathered at the neck to a sort of frill, which is inclosed by a torques. The tunic reaches to the feet.

Over it Menimane wears the stola, which reaches only a little below the knees, and hangs loosely and gracefully over the breast. As Mr. Roach Smith observes, her jewelry is of no common description, nor niggardly bestowed. Upon her breast, below the torques, is a large rose-shaped ornament or brooch, and beneath it a couple of fibulæ; two more, of a similar pattern, fasten the stola near the right shoulder, and upon the left arm just above the elbow; an armlet encircles the right arm, and bracelets the wrists; and two of the fingers of the left hand have rings. Her hair is raised up into what was probably the fashionable *coiffure* of the day. This profusion of jewelry, and the money-bag which Blussus holds in his hand, bespeak a family of no inconsiderable wealth. The boy behind holds what is probably intended for a ball; and the mother, in spite of her brilliant attire, grasps in her hand the implements of weaving, to typify her attention to her household duties, and has on her lap her pet little dog. The couple sit in one chair, which casts a pleasing air of domesticity over the whole picture.

Our next cut represents a young maiden of the Roman town of Burdigala, the modern Bordeaux, where the monument was found. Her name has been lost by an accidental erasure of part of the inscription, and we only know the name of the father who raised this monument to her memory, which was Lætus. She also wears the tunic, and the outer garment (answering to the stola of the Romans), which here reaches lower than in the former instance. Her hair is dressed somewhat in the same style as that of the navigator's wife, and like her, also, she has her pet animals, in this instance, a kitten and a cock. There is a special interest attached to the former, as the domesticated cat is not mentioned in the ancient writers, and it has been recently asserted by one of our distinguished men of science that the cat was never domesticated by the Romans. The love of the Roman ladies, and sometimes the gentlemen also, for domesticated animals is well known. Every reader of the classic poets is acquainted with Lesbia's sparrow (*passer*) and Corinna's parrot. Martial has commemorated, in a graceful epigram, the qualities of Issa, the favourite little dog of the painter Publius.

> "Issa est blandior omnibus puellis;
> Issa est carior Indicis lapillis;
> Issa est deliciæ catella Publi."—Martial, "Epig.," i., 110.

And in another epigram he has furnished us with a list of the favourite pet animals of his time. The archæological discoveries at

Bordeaux have furnished us with another monumental figure of a young damsel of Burdigala, which is represented in the cut on the right. Her name is given in the inscription, as will be seen, as "*Axula, Cintugeni fi*[*guli*] *filia,*" Axula, the daughter of Cintugenus the potter. It is the first sepulchral monument with the name of a potter which has been discovered; and Cintugenus must have been a

A MAIDEN OF BORDEAUX (*Burdigala*).

THE POTTER'S DAUGHTER OF BURDIGALA.

man of wealth and distinction in his profession, for Mr. Roach Smith, to whom we owe the publication of this interesting monument, has not only traced the name of the family in other Roman monuments in the Museum at Bordeaux, but he has found it stamped as the name of the maker on Roman pottery found in London. Axula has rather a short dress, which exposes to view a well-defined pair of shoes; she holds in her left hand a basket of fruit, and in the right a mirror of the well-known Roman form, perhaps as one of the

first implements which the Romano-Gaulish damsel was taught to use.

The only other Romano-Gaulish female I have to show is a lady of Nemaustum—now represented by the town of Nîmes—which was engraved by the Comte de Caylus in the third volume of his "Recueil d'Antiquités." It is a head, sculptured in relief, and is interesting as giving an example belonging to the Roman period of the head-covering of the females. We will pass from it into our own island of Britain, where we are again indebted to the indefatigable labours of Mr. Roach Smith. Our next cut represents a piece of a broken monument belonging to the Roman town of Lindum, in Britain, which was dug up some years ago in the immediate

A LADY OF NÎMES (*Nemaustum*).

A LADY OF LINCOLN (*Lindum*).

neighbourhood of its modern representative, Lincoln, and is now preserved in the cloisters of the cathedral. It is, no doubt, intended for the portrait of a lady who lived in the ancient Roman town, and is interesting as an illustration of the costume of a British female of her age, which Mr. Roach Smith places under the reign of Severus, or very soon after—that is, in the earlier part of the third century of the Christian era. She wears, evidently, the tunic and the stola, the former terminating in what bears some resemblance, like that of Menimane, to a frill, the latter open in front; but the object of most interest is her necklace, which is evidently formed of jet beads, resembling those which are found not unfrequently on ancient sites, and especially on sepulchral interments in Britain. They are flat on one side, and ribbed on the other, and were no doubt of native manufacture.

DRESS OF A NORTHUMBRIAN MATRON UNDER THE ROMANS.

Our last cut is that of a statue found at Chesters, in Northumberland, the site of the Roman station of Cilurnum. The tunic, reaching to the feet, and the stola, descending only a little below the knees, are well and distinctly pictured, and may probably be considered as representing those articles of dress as worn by a lady of rank in the country to the north of the Humber. The character of the waist-band, or girdle is especially remarkable. The statue appears to have been intended for that of a goddess—supposed to be Cybele, who is worthily represented in the well-known garb of a matron. It is to be regretted, however, that our Romano-British matron has lost her head.

In these few sculptured monuments, we have seen something of the appearance of the ladies of Gaul and Britain during the time they remained Roman provinces. The same class of monuments furnishes us with some curious illustrations of the domestic sentiments as they prevailed—or, at all events, existed—during the same period. It was the practice of the Romans to make of their tombstones affectionate memorials to the departed on the part of

the survivor, and the inscriptions often contain traits of personal character which, if not always strictly true, tell us at least what were the qualities which the people of those days valued most in the female sex. It is thus among the abodes of the dead that we must seek for the last traces of the virtues of Womankind in Roman Gaul and Britain. We find these memorials of affectionate feelings at the very extremity of our British province. At Chesters, in Northumberland (*Cilurnum*), a station on the line of the Wall of Hadrian, an altar monument was found, dedicated by Fabius Honoratius and his wife, Aurelia Egliciane, to the memory of their "most sweet daughter" (*filiæ dulcissimæ*), who was named after her father, Fabia Honorata. They were a family of Vangiones—a people of Belgic Gaul. At Carvoran, another Roman site on the line of the Wall, a monument was inscribed by a centurion, named Aurelius Marcus, as a testimony of his affection for "his most holy wife, who lived thirty-three years without a single stain."

OBSEQVIO CON
IVGIS SANCTIS
SIMAE QVAE VI
XIT ANNIS XXXIII
SINE VLLA MACVLA.

The lady in this case was a native of Salona.*

If we go over to Gaul we shall find these affectionate memorials in greater numbers. Many of them have been collected by Orellius, in his valuable work on "Latin Inscriptions," and in the supplementary volume by Henzen. Some of the more common epithets applied by husbands to their wives in these early inscriptions are "most affectionate wife" (*uxor piissima*), "most dear spouse and wife" (*sponsa ac marita karissima*), "most innocent woman" (*innocentissima femina*), "incomparable woman" (*incomparabilis femina*). Many of these monuments have been found at Lyons, on the Rhone, the Lugdunum of the Romans. One of them was dedicated by Silenius Reginus to his most dear sister, Camilla Augustila, "who lived thirty years and five days, and for whom none of her kin ever grieved except at her death."† Two of these ladies of Lyons, most remarkable for their virtues, were Greeks by birth. One, Lanina Galatia, had lived, according to her husband's testimony, thirty years without any sin. ‡ Arelatum, also, the modern Arles,

* These inscriptions are published by Dr. Bruce, in his great work on "The Roman Wall."

† "De qua nemo suorum unquam doluit nisi mortem." Orellius, vol. ii., No. 4464.

‡ "Quæ vixit annos xxx sine ulla animi læsione." Orellius, vol. ii., No. 4465.

appears to have furnished some good examples of Womankind. A young married woman named Julia Lucia, who died at the age of twenty years and eight months, is declared by her husband and father-in-law, who erected the monument, to have been, "in morals as well as in accomplishments an example for the rest of Womankind."* The wife of a citizen of Narbonne was "dutiful and thrifty." A lady of Avignon, or, at least of the neighbourhood, was "dutiful and chaste," and her husband, in his regard for her, dedicated to her "the best memorial his poverty would permit."†

The ladies, be it said to their credit, were not in arrear with their husbands in these testimonials of affectionate feeling. A townswoman of the Roman Lugdunum of the Batavi, now Leyden, named Nævia Fortunia, speaks of her deceased spouse as "an incomparable husband, with whom she had lived nineteen years."‡ A monument raised, on the other hand, by a husband to his wife but found in Italy instead of Gaul, gives us rather an interesting enumeration of what were considered to be the domestic virtues of an excellent woman. The literal translation of this memorial, which was inscribed on a sarcophagus, is, "Here has been laid Amymone, the daughter of Marcus, in character most excellent, in person most beautiful, a diligent plyer of the distaff, affectionate, modest, thrifty, chaste, *and a keeper at home.*"§

In all the long list of affectionate memorials from husbands to their wives, I have only met with one example of a contrary character, and I rejoice to say that it was not found within the limits of Britain or Gaul. It belongs to Rome itself. A Roman named Marcus Ulpius Cerdo, it tells us, "has erected this monument to his dearest wife, Claudia, daughter of Tychenus, with whom he lived two years, six months, three days, and ten hours. On the day of her death I gave the greatest thanks before gods and before men."‖ The period of his married life must, indeed, have weighed heavy upon Marcus Ulpius Cerdo, when he reckoned it up so minutely.

* "Quæ moribus pariter et disciplina ceteris feminis exemplo fuit." Orellius, vol. ii., No. 4638.

† "Conjugi piæ et castæ . . . . maritus qualem paupertas potuit memoriam dedi." Orellius, vol. ii., p. 220, No. 4648.

‡ "Conjugi incomparabili cum quo vixit annos xix." Orellius, vol. i., No. 171.

§ "Hic sita est Amymone Marci, optima et pulcherrima, lanifica, pia, pudica, frugi, casta, domiseda." "Orellius," vol. ii., No. 4639.

‖ "Cum qua vixit annis ii., mens vi., dieb. iii., hor. x. In die mortis gratias maximas egi aput deos et aput homines." Orellius, vol. ii., No. 4636.

THE HOUSE OF LORDS.

BY FRANCIS W. ROWSELL, BARRISTER-AT-LAW.

THE House of Lords, as at present constituted, consists of the Archbishops of Canterbury and York, twenty-four English bishops, one Irish archbishop, three Irish bishops, all English barons who have attained twenty-one years of age, sixteen Scotch peers, and twenty-eight Irish peers; the two last classes being the elected representatives of the body of their fellows. These make up the total of spiritual and temporal lords of Parliament.

The Scotch and Irish peers were admitted in 1707 and 1801 respectively, the dates of the union of their countries with England; and before the 33 Henry VIII. c. 13, by which Act all monasteries and abbeys were suppressed, the roll of English spiritual peers (increased as regards the number of bishops since that time) was strengthened by the addition of twenty-seven mitred abbots and two priors. There are two English bishops, besides the above-mentioned twenty-four, but they have no seats in the House; one of these is the Bishop of Sodor and Man, the other is the junior bishop, unless he be of the diocese of London, Durham, or Winchester. These sees are always represented.

The temporal peers must be barons, though, in addition to this dignity, they may have any higher titles of nobility, as dukes, marquises, earls, viscounts. Baron is the minimum degree of qualification for a peer of Parliament. But peerage being a social rank, as well as a qualification for a seat in Parliament, its dignities are classed for purposes of precedence as follows:—viz., 1. peerages which in their creation were peerages of England; 2. peerages of the United Kingdom of Great Britain; 3. peerages of the United Kingdom of Great Britain and Ireland; 4. peerages of Scotland; 5. peerages of Ireland.

The House of Lords is at the same time a legislative assembly and the highest court of justice in the kingdom. That which answered to it under the Saxon Heptarchy was composed not only of the great chiefs with titles of nobility, but of the principal landowners and others interested in property, together with all the bishops and abbots, who sat in accordance with a custom which obtained amongst all the northern nations, and which secured for the state the advice and learning of the best informed men of the age. The Norman conquest made a change in the constitution

of the English Great Council. Under the peculiar circumstances with which the Normans found themselves surrounded, as conquerors in a country where the people were possessed by an undying hatred for them, it became necessary that the governing body should consist of men who were more or less dependent on the king, or rather who were bound together by interests which they had in common with him and with each other. So the Great Council of the kingdom to which William I. looked for advice was composed wholly of men who held baronies, or military fiefs, directly from the Crown, and they were called, in the language of the law, the king's tenants *in capite*. The ecclesiastics, who in the Saxon times had sat by virtue of their supposed superior wisdom, were not exempted under the Norman rule from the essential qualification of baronage. Granted that they sat by the same title as formerly, the necessity of their rendering military service for the baronies they held was superadded, and without a barony they could not sit at all.

But it is obvious that the attendance of all the tenants in chief of the king at the king's council must soon have been found inconvenient, if not to the king, at least to some of the tenants; and before the reign of Henry III. a custom appears to have prevailed, that, besides being a tenant of the king, it was necessary, in order to constitute him a lord of Parliament, a tenant should receive a special writ of summons. The greater barons had their particular writ from the king, and the lesser barons were summoned generally by proclamation of the sheriff. These lesser barons, either from indifference, from dislike of the expense of attending, or from whatever cause, soon got to disregard their summons to Parliament, so far as they individually were concerned; but, in order that their interests might not be unrepresented in the Council of the nation, they chose certain knights out of their body, who should go to Parliament, and speak there for them all; and these knights of the shire—afterwards developed into the county members of the House of Commons—represented in Parliament those tenants of the king to whom special writs of summons had not been sent.

For some time baronage by tenure, and then tenure coupled with a writ of summons, constituted the claim to be a lord of Parliament; but another mode of creating a peer came into vogue about the time of Richard II., who created Sir John Holt a peer by royal patent unconnected with tenure. Before that time, and down to the reign of Henry VII., it seems to have been the practice to summon to Parliament persons, who certainly were not peers by

tenure, by means of a writ addressed specially to them. Whether they were considered as on an equality with the other barons, which is most likely; whether, having once been summoned, they had a right always to be summoned; and whether they were not summoned in virtue of being heirs to, or having intermarried with the representatives of, some barony, are questions not conclusively settled; but it is certain that persons were summoned, and actually sat in the House of Lords, by virtue of writs which were not always renewed, and which undoubtedly were not of necessity issued to their descendants. These were called barons by writ.

There was another method of making peers, viz., by Act of Parliament; but Mr. Hallam qualifies this method by saying that the peerages created by it were only of the highest kind, as of duke or earl, and suggests that while the consent of the Lords and Commons is expressed to the new dignity, it was only by way of further assurance, and was not essential—the king being then as now the source and fountain of honour. Edward III. made several peers in this way; Richard II. granted the new title of "Marquis" of Dublin to his favourite Vere, with full consent of all the estates. Henry V. made his brothers Dukes of Bedford and Gloucester in the same way; and in the reign of Henry VI. Sir John Cornwall was made Lord Fanhope "by consent of the Lords, in the presence of the three estates of Parliament."

Peers were therefore Lords of Parliament by virtue of tenure, tenure and summons, writ, Act of Parliament, and patent. At one time they constituted the only legislative assembly in the kingdom, and they continued to be so even after the admission of the representatives of towns among their members; for it was not until an insecure dynasty came upon the throne, dependent in a great measure upon the good will of the people for support, that the consent of the Commons, whose functions had been hitherto only to vote the taxes which their towns should pay, was invited to agree to enactments of a purely legislative character. In the twenty-eighth year of his reign Edward I. ratified the statute of Winchester "at the request of his *prelates, earls, and barons,* assembled in his Parliament holden at Westminster;" and he assented to the 35 Ed. I., st. 1., "by the counsel of his earls, barons, great men, and other nobles of his kingdom." The first decided mention of the Commons as an assenting body is in the statute 7 Ed. II., "Ne quis occasionetur pro reditu Petri de Gaveston," and there is a statute of Edward II., quoted in the first report of the Lords on the dignity of a peer (1819), though not mentioned by Ruffhead, which declares the consent of *all* estates

to be necessary to legislation; but it was, nevertheless, not until quite the latter part of the reign of Edward III. that the concurrence of both Houses in legislation was made essential. Statutes of Edward III. are expressed to be passed "at the petition of the Commons, and by the assent of the Lords;" at the request of the Commons it is "enacted by the king and his Lords"; by the consent of "the prelates, earls, barons, and other great men of our realm;" "upon deliberation and treaty with the prelates and the nobles, and learned men assisting us." A statute passed in the first year of Richard II. is "by the whole consent of the prelates, etc., at the instance and especial request of the Commons of our realm." From Henry IV. to Henry VI., the enacting clause runs "by the advice and assent of the Lords spiritual and temporal, and at the special instance and request of the Commons of the realm, being in the same Parliament." It was not, therefore, until the House of Lancaster came to the throne that the concurrence of both Houses in legislation, a privilege fought for rather than enjoyed under Richard Plantagenet, was established as a constitutional point; and thenceforth the peculiar characteristic of the House of Lords as the sole legislative assembly was gone for ever. It continued, however, to be distinctive in its character of Grand Council of the king, and even so late as 1640, the year in which the last summons was issued to tenants by knight service to follow the king to a foreign war (the war of Charles I. against the Scots), the king rather than meet a regular Parliament convoked the Grand Council of the peers to meet him at York, there to advise him as to the course he should pursue. Such a Council was, of course, useless as a substitute for a Parliament, and the only advice it gave to Charles was that he should call a Parliament as soon as possible. Since that time no like attempt has been made to revive the dead function of the House of Lords, either solely to legislate or solely to advise. Some trace of the latter privilege is, perhaps, to be found in the theory of the constitution of the Privy Council, and in the right which every peer has at any time to approach his sovereign, and to offer such advice as may seem to him reasonable.

As a Court of Justice, however, it still enjoys all its ancient rights, though practice has limited its jurisdiction to the hearing of appeals, and deprived it, except for the purposes of impeachments and the trial of its own members, of its authority as a court of first instance. Originally, it was the only tribunal before which complaints could be brought, at the same time that it was the only body in the State which could make laws. About John's time, the

Committees of the House to which such complaints were commonly referred, were erected into the permanent Courts of King's Bench, Common Pleas, and Exchequer, the judges of which are to this day, in recognition of their judicial origin, called Lords Justices in the first two courts, and Barons in the Exchequer. More than this, they also receive, at the calling of every new Parliament, writs of summons to the House of Lords, where seats are specially set apart for them. The object, however, of summoning them is only that the House may have the benefit of their advice if needed; and whenever that is so, a special notice, without which they are not expected to attend, is sent to them. The writ of summons differs from that sent to other lords, in that the words *ad consentiendum*, are left out.

On the principle that the power which the House thus delegates is inherent and intact within itself, the House of Lords both entertains appeals from all the courts, which are its committees, and claims to have an original jurisdiction in all cases whatsoever. This latter claim, however, was vehemently opposed by the House of Commons in the case of Skinner, in Charles the Second's time; and seems moreover, to be counter to the fundamental principle of English law, that a man shall be tried by his peers. The claim is, moreover, objectionable because it does not admit of any appeal, since there cannot be an appeal from the decision of the highest court in the realm.

The case of Skinner was briefly this:—Thomas Skinner, a merchant, petitioned the king (Charles II.) to notice that he had gone as a merchant to the Indian seas, at a time when there was no restriction upon Indian trade; that the East India Company had taken away his ships, his property, and an island which he had bought of a native prince; and he prayed his Majesty to afford him redress. The Privy Council failed to settle the matter, so the King sent all the documents to the House of Lords, with a recommendation to do justice to the petitioner. The House overruled the exceptions taken to its jurisdiction, and awarded Skinner five thousand pounds damages. The East India Company petitioned the House of Commons, which referred the case to a committee; and the committee reported that the House of Lords, in taking cognizance of an original complaint, relievable in an ordinary court, had acted illegally, and in a manner to deprive the subject of the benefit of the law. In return for this the Lords voted, "That the House of Commons, entertaining the scandalous petition of the East India Company against the Lords' House of Parliament, and their pro-

ceedings, examinations, and votes thereupon had and made, are a breach of the privileges of the House of Peers, and contrary to the fair correspondency which ought to be between the two Houses of Parliament, and unexampled in former times; and that the House of Peers, taking cognizance of the case of Thomas Skinner, merchant, a person highly-oppressed and injured in East India by the governor and company of merchants trading thither, and overruling the plea of the said company, and adjudging five thousand pounds damages thereupon against the said governor and company, is agreeable to the laws of the land, and well warranted by the law and custom of Parliament, and justified by many Parliamentary precedents, ancient and modern."

Two conferences which took place in consequence of this declaration proved abortive, neither side consenting to withdraw from its assumed position. Skinner was ordered into custody by the House of Commons for a breach of privilege; and Sir Samuel Barnardiston, the chairman of the East India Company, and a member of the Lower House, was in return sent to prison by the House of Lords, and fined five hundred pounds. The king tried to stop the quarrel by prorogations and adjournments; but after these had continued fifteen months the heat had not cooled down, and, at the recommendation of the king, the record of all that had been passed on the subject was erased from the journals of the two houses. This was done, and there the matter dropped. "From this time," says Mr. Hallam, "the Lords have tacitly abandoned all pretensions to an original jurisdiction in civil suits."

In presentments of a criminal nature, however, their power in certain cases is as full as ever it was, viz., for the trial of any of their own members who may be accused of felony, and of such persons, whether peers or commoners, as may be impeached before them by the House of Commons. Jurisdiction in the former case is given by the fundamental rule of criminal procedure, recognized in Magna Charta, though older than it, which declares that every man shall be tried by his peers when put on his trial for felony. At one time the privilege of peerage in this respect extended to the trial of misdemeanours, but now a peer is liable to be tried before a jury for this class of offences.

The second case in which the House of Lords may be called upon to sit as a Court of Justice in criminal issues, or even on charges of misdemeanour, is the case of an impeachment by the House of Commons. An impeachment involves an accusation by the Commons of England, and the trial of the accused by the

Lords. It is beneath the dignity of the House of Commons to appear before any court but the highest. That House is not, never has been, a Court of Justice itself for any other purpose than that of administering the law of its own privileges; and, except in the extravagant case of Mr. Floyd in the reign of James I., in which its usurpation of power was at once and strenuously opposed, it never has pretended to judicial functions. But, as the representative of the Commons, it early arrogated the right to stand forth as the accuser of any one whose conduct had made him justly obnoxious to the nation at large; and this accusation, for the reason already given, was to be presented only to the House of Lords, who should also try the issue. The first case of parliamentary impeachment was in 1376, towards the end of Edward the Third's reign, when the Lords Latimer and Nevill, and four commoners, were accused by the House of Commons of having caused the staple to be removed from Calais, where the Parliament had fixed it; of having lent money to the king, at an exorbitant rate of interest; and of having bought up, at a low rate, certain old debts of the Crown, which they afterwards induced the king to pay them in full.

In the fourth year of Edward III., *the king* accused Sir Simon de Bereford to the Lords, of having participated in the treason of Roger Mortimer, and the House protested "that, albeit they had taken upon them, as judges of the Parliament, in the presence of the king, to render judgment, yet the peers who then were or should be in time to come were not bound to render judgment upon others than peers, nor had power to do so; and that the said judgment thus rendered should never be drawn to example or consequence in time to come, whereby the said peers of the land might be charged to judge others than their peers, contrary to the laws of the land." This protest, be it observed, was against charges instituted by the king, to whom the regular courts were open, so that he had no need to resort to this special tribunal. It is also to be remarked of the 29th chapter of Magna Charta, already alluded to, that the declaration as to trial before equals contained in it has reference only to suits instituted by the king. The case of so extraordinary an accuser as the whole people of England was not provided for, either by the common law or by statute, and it was only established by actual practice in the case quoted above, in several cases under Richard II., and in the case of the Duke of Suffolk under Henry VI.

Between Henry VI. and James I. no case of impeachment, properly so called, occurred; but in the latter king's reign Sir Giles

Mompesson, Michell, a Justice of the Peace, Sir J. Bennet, Judge of the Prerogative Court, the Bishop of Llandaff, Lord Bacon, and the Earl of Middlesex, were impeached and duly tried before the Lords. In the reign of Charles I., besides the Earl of Strafford and Archbishop Laud, several commoners were impeached, and not any objection was made by the Lords to try the cases; but in 1681, when Fitzharris was impeached of treason, the Lords voted that he should be pursued at common law. The House of Commons, in consequence, passed a resolution, "that it is the undoubted right of the Commons in Parliament assembled to impeach before the Lords in Parliament any peer or commoner for treason, or any other crime or misdemeanour: and that the refusal of the Lords to proceed in Parliament upon such impeachment is a denial of justice, and a violation of the constitution of Parliament." There is now no question but that the House of Lords has the right, which it is bound to exercise, of trying any one, peer or commoner, on charges presented by the House of Commons.

The privileges of peers are—1. That every lord, spiritual or temporal, summoned to Parliament, and passing through the king's forests, may, both in going and returning, kill one or two of the king's deer without warrant, in view of the forester if he be present, or on blowing a horn if he be absent, that he may not seem to take the king's venison by stealth. 2. That they may give their proxies to other peers, to vote as their representatives, a privilege not enjoyed by the members of the Lower House, because they are themselves but the representatives of others. 3. They may enter their protest, or written reason for dissent, against any Bill which passes contrary to their votes. 4. All Bills affecting the peerage must be originated in their House, and cannot be altered out of it. 5. Peers are free from arrest in civil suits in all cases, even when Parliament is not sitting, because they are supposed to be either advising the sovereign, as one of his Great Council, or defending his kingdom, as one of his military tenants. 6. They have the right of access, individually, at all times, to the sovereign—a privilege which the House of Commons enjoys only collectively. 7. On trials for high treason they have a right to be tried by all the peers entitled to sit and vote in Parliament.

Peers are not sworn, but give their evidence and their verdict "upon their honour." In case of giving verdicts, the youngest peer is first called upon for his vote.

In 1648 the Commons passed a resolution, that the House of Peers was useless and dangerous, and ought to be abolished. It

was abolished until the restoration of the monarchy, the Lords meantime retaining their titles both in public and private use, and some of them even consenting to sit in the Lower House as county members. In 1641 Charles I. consented to a Bill for ousting the bishops from Parliament, and they ceased to form any part of the Legislature till their restoration by the first Parliament of Charles II., held after the dissolution of the Convention Parliament.

Though strong arguments have been urged in favour of life peerages, and some sort of precedent might be found for them in the baronies by writ, already mentioned, the House of Lords have ever firmly resisted the claim of the Crown to grant them; and in the case of the present Lord Wensleydale, they declined to let his lordship sit until the peerage conferred on him for life was recalled, in favour of one made out with the usual limitations to heirs.

Lord Coke tells us that, at the time he was writing, the temporal peers numbered 106. The roll of peers at the beginning of the present Parliament showed 465 names, including 4 peers of the blood royal, 30 spiritual, and 431 temporal lords. The Bishop of Chester was the junior bishop (then without a seat in the House), and among the names last added to the roll of temporal peers were those of Lord Cairns and Lord Strathnairn (Sir Hugh Rose).

ON THE NEW THEORIES IN CHEMISTRY.

BY F. S. BARFF, M.A. CANTAB., F.C.S.,

Assistant to Professor Williamson, F.R.S., University College.

No. I.

THE object of these articles is not to lay before the reader anything new with respect to modern chemical theories, neither do they profess to represent them in a more clear and philosophical manner than has been done by the eminent chemists Williamson, Wurtz, Nacquet, and Kekulé. In this respect they can bear no claim to a comparison with the works of these distinguished professors, to whose treatises those who desire to follow out the subject fully are referred. There is, however, a large class of scientific men whose labours in other directions prevent their keeping themselves *au courant* with the rapid advances made in chemical science, and who, years ago, laid the foundations of their chemical knowledge in a school whose teachings have almost entirely given place to other and newer theories. Such persons hesitate in entering on an investigation which seems like beginning their work afresh, and they dread giving up their hold on what they have always regarded as fixed and settled, to grapple with theories, which, even their advocates, cannot but admit are open to further change and modification. But men, whose pursuits are scientific, can hardly rest contented with the knowledge of any science as it stood twenty years ago; they cannot afford to wrap themselves up so completely in their own particular studies, as to ignore progress in one which affects more or less all branches of natural science, and underlies all their phenomenon. Anatomy, physiology, geology, botany, all are receiving help from chemistry, which is, in a manner, changing the method of their study, and opening out in them new fields for investigation, in which chemical knowledge of no mean degree of accuracy is required; and the chemistry to be employed is not the chemistry of the past, but of the present, not that in which facts were represented so as to support theories, but where theories, formed from careful observation of facts, are only maintained as long as they lead to their elucidation. There are also many students who have made themselves acquainted with the facts of elementary chemistry, but who have yet to learn the connection subsisting between them, and who are consequently unable

to appreciate the theories which have been formed concerning chemical combination, or to recognize their importance in facilitating the acquisition of sound chemical knowledge, according to a method which supplies a valuable training for the mind.

We shall find the best mode of approaching theoretical chemistry is through experimental fact.

If eighteen grammes* of water be decomposed by the galvanic current, hydrogen is given off at the negative, and oxygen at the positive pole of the battery; the weight of hydrogen will be two grammes, and that of the oxygen sixteen grammes. Thus hydrogen is seen to combine with oxygen in the proportion of two to sixteen, or of one to eight; the symbolic value of oxygen, therefore, hydrogen being taken as one, is eight. If thirty-nine grammes of potassium be made to act on water, and if the excess of water be evaporated and the residue heated, the product will be found to weigh fifty-six grammes, and to contain sixteen grammes of oxygen, one of hydrogen, and thirty-nine of potassium—

$$\underset{(18\text{ grms.})}{H_2O} + \underset{(39\text{ grms.})}{K} = \underset{(39\text{ grms.})}{K} \quad \underset{(1\text{ grm.})}{H} \quad \underset{(16\text{ grm.})}{O} + \underset{(1\text{ grm.})}{H}.$$

The same weight of hydrogen being set free as combines with the potassium and oxygen. If this substance be fused with potassium, one gramme of hydrogen will be driven off, and thirty-nine grammes of potassium will take its place, thus—

$$\underset{(39\text{ grms.})}{K} \quad \underset{(1\text{ grm.})}{H} \quad \underset{(16\text{ grms.})}{O} + \underset{(39\text{ grms.})}{K} = \underset{(94\text{ grms.})}{K_2O} + \underset{(1\text{ grm.})}{H}.$$

The resulting compound K_2O will weigh ninety-four grammes. In the first of these experiments thirty-nine grammes of potassium have been made to take the place of one gramme of hydrogen, in the second the other gramme of hydrogen has been replaced by thirty-nine grammes of potassium; thirty-nine grammes of potassium are therefore equivalent to one gramme of hydrogen or eight grammes of oxygen, making the assumption that combination and replacement are the same thing. Now if the latter compound of oxygen and potassium be treated with hydrochloric acid, and be heated to a temperature, insufficient to volatilize any of the salt formed, it will be found to weigh one hundred and forty-nine grammes, and, on analysis, to contain only potassium and chlorine,

* A gramme is equal to 15·432349 English grains.

there being twice thirty-five point five grammes of chlorine, and twice thirty-nine grammes of potassium, thus—

$$K_2O + 2\,(H\,Cl) = 2\,(K\,Cl) + H_2O.$$

The compound of potassium, hydrogen, and oxygen will give, with hydrochloric acid, a potassium salt, in which thirty-nine grammes of potassium are combined with thirty-five point five* of chlorine, one gramme of the hydrogen uniting with the hydrogen of the hydrochloric acid, and the oxygen of the potassium compound to form water, thus—

$$K\,H\,O + H\,Cl = K\,Cl + H_2O.$$

It appears, therefore, from these two last experiments, that thirty-five point five grammes of chlorine are equivalent to thirty-nine grammes of potassium, or to one of hydrogen; and that in the compound K_2O, obtained by replacing the two hydrogens of water by two potassiums, the oxygen has been replaced, in the first instance, by twice thirty-five point five grammes of chlorine, and in the second by thirty-five point five grammes of chlorine and one of hydrogen; and as thirty-five point five grammes of chlorine are equivalent to one gramme of hydrogen, two grammes of hydrogen can replace sixteen grammes of oxygen, and as sixteen grammes of oxygen are eight times as heavy as two grammes of hydrogen, they are sixteeen times as heavy as one gramme of hydrogen; and this proportion holds good whatever weights may be taken. In these illustrations definite weights have been supposed, because it is easier for many minds to grasp an idea presented to them in this form than when it is at first dealt with in the abstract. If we can conceive a particle of an element, so small that it admits of no further division, and which is capable of entering into combination with another such particle of the same element, or of any other element, we shall understand what is meant by the word atom, as used in the assumption of the atomic theory. That the atoms of different elements have not the same weight, is clear from the illustrations before given, in the action of potassium on water, in which it was shown that the hydrogen was displaced in two successive stages, and that the atom of oxygen weighs sixteen times as much as the atom of hydrogen. The example was given in grammes, and whatever were the relative weights of these two elements in this instance, that relation remains the same for any, even the most minute divisions of them. Hydrogen being the lightest body known is taken as

* 35·5.

the standard, and to it, as I, the atomic weights of all known elements are compared, and if these elements can only combine with hydrogen in the proportion of their atomic weights, it is clear that they can only combine with one another in the same proportion; that is, if the atom of oxygen, sixteen, is the smallest quantity of oxygen which can combine with the atom of hydrogen which equals one, and if the atom of carbon equalling twelve (the atomic weight of carbon) is the smallest quantity of carbon which can combine with hydrogen equalling one, carbon and oxygen combine in the proportion of twelve to sixteen.

Dalton devised the atomic theory to explain observed facts, and, whatever changes may take place with respect to it, whether it will continue to be held by chemists as it has hitherto been, as a satisfactory explanation of those facts, or whether there are grounds for the dissatisfaction expressed concerning it in certain quarters, is beyond the scope of these articles to discuss; one thing, however, is certain, that to it we owe a lasting debt of gratitude, for on it has been founded our present advanced knowledge, and the simplification of the laws relative to chemical combination. We have already seen that in water, one atom of oxygen, whatever be its weight, whether sixteen grammes or sixteen pounds, combines with two atoms of hydrogen, each weighing either one gramme or one pound. If two measures of hydrogen and two of oxygen be mixed, and then be caused to unite by an electric spark, only three measures of gas will remain, that is, supposing the water formed to be in the gaseous state, two volumes will consist of water vapour, and one of oxygen will remain uncombined, so that only two measures of hydrogen weighing two grammes, and one measure of oxygen weighing sixteen grammes, can, under these and similar circumstances, combine together. The condensation which takes place when some gases unite to form other compound gases, will be noticed afterwards. It may be well to remark here, to avoid misconception, that another compound of oxygen and hydrogen can be formed, in which two atoms of hydrogen unite with two of oxygen, but the combination is not effected directly, as appears from the fact that, where the two gases are mixed in these proportions and combination is effected by the electric spark or by heat, one atom of free oxygen is left. The body H_2O_2 can only be obtained by indirect methods, and the union of the second atom of oxygen is so weak, and the compound so very unstable, that it is easily decomposed. The composition of this and other similar bodies, will be treated of fully in a future article. The property which oxygen has

of combining with two atoms of hydrogen, has been called its atomicity, and oxygen has been termed diatomic. This word certainly does not express the property, for it is not the oxygen which is di-atomic, the oxygen is but one atom, it is truly mon-atomic, but it has the property which enables it to hold two atoms of hydrogen in combination, and which will not permit it to hold less than two of this element, or of an element similar to hydrogen, as potassium, or one atom of hydrogen together with one of a similar element. The compound HO when H = 1 and O = 16 cannot exist in the free state. Various words have been suggested to express this power. Some have proposed to call it dynamicity, but Professor Williamson in his lectures at University College, advises the use of the word valency or valence instead of atomicity, and this really seems to express what conceptions can be formed of this property of elements. Adopting this suggestion, oxygen would be termed divalent in water, nitrogen trivalent in ammonia NH_3, and carbon tetravalent in marsh gas CH_4. Experiment proves that elements combine with one another in various proportions, for example, oxygen combines with nitrogen in five different proportions.

Nitrous oxide N_2O.
Nitric oxide N_2O_2.
Nitrous acid N_2O_3.
Peroxide of nitrogen N_2O_4.
Anhydrous nitric acid N_2O_5.

Somewhat similar compounds are formed by oxygen and chlorine, but in all these cases the combinations take place in the proportion of multiples of the atomic weights of the different elements. It was from these facts that Dalton framed his law of multiple proportions, and assuming his definition of an atom to be correct, no different combining proportions can exist, and none others have been discovered by experiment than 28 of nitrogen to 16 of oxygen in N_2O; 28 : 32 in N_2O_2; 28 : 48 in N_2O_3; 28 : 64 in N_2O_4; and 28 : 80 in N_2O_5. In carbonic oxide, oxygen combines with carbon in the proportion of sixteen to twelve, in carbonic acid in that of thirty-two to sixteen. In these compounds, containing different proportions of the same elements, distinctly different properties are observed. Nitrous oxide supports combustion like oxygen, but less energetically; nitric oxide does not—it, however, takes up oxygen readily, and forms a red coloured gas which has acid properties, uniting with bases to form salts. Per-

oxide of nitrogen is a red gas, which does not enter into such combinations, and anhydrous nitric acid in the presence of water, becomes nitric acid. Carbonic oxide burns, takes up oxygen to form carbonic acid, and destroys life as a poison, while carbonic acid neither burns, nor supports combustion, except under certain circumstances, as when potassium is oxidized in it, and destroys life by excluding oxygen. A difficulty may arise here which, perhaps, ought to be noticed before proceeding further. If the elements have the power of combining with one another in definite proportions, how comes it that if oxygen is divalent, and nitrogen trivalent, such compounds exist as those just referred to, in which oxygen combines in such different proportions with nitrogen and carbon (the proportions, however, still being in multiples of their atomic weights). To take the case of carbon, it forms two oxides, carbonic oxide CO, and carbonic acid CO_2; carbon is tetravalent, oxygen is divalent. In carbonic oxide, one atom of tetravalent carbon is combined with one atom of divalent oxygen; in carbonic acid, one atom of tetravalent carbon is combined with two atoms of divalent oxygen. In carbonic oxide it is supposed that the oxygen satisfies the carbon to the extent of half its combining energy, and that the remaining carbon satisfies itself. Suppose that the atom of carbon has a combining force which is represented by four, and is equal to the force of four atoms of hydrogen, each being equal to one, and that it is satisfied by them as in marsh gas CH_4. Now oxygen has a force which is equal to that of two atoms of hydrogen, and is satisfied by them, as in water, H_2O. If one atom of oxygen be combined with one atom of carbon, its two forces will neutralize or satisfy two of the forces possessed by the atom of carbon, but there will still remain in the carbon two forces unsatisfied, and these are considered in such combinations to satisfy one another. This explanation is introduced here, though it properly belongs to a more advanced consideration of the subject, because the writer felt this difficulty, in his earlier chemical studies, to be one, which rendered obscure many points which might have been, in a great measure, cleared up, had he been aware of the way in which chemists regarded chemical combinations. In carbonic acid the atom of carbon is completely satisfied by the two atoms of oxygen, as is the oxygen by the two atoms of hydrogen in water, no further oxidation of the carbon can take place; but in carbonic oxide, where only half the carbon is satisfied by oxygen, and where carbon in part satisfies itself, there is a readiness, so to speak, to take up another atom of oxygen, whereas if a compound is saturated,

it is difficult in all cases to cause further addition of an atom of its constituent elements, as in H_2O_2, and in many cases it is impossible, as in CO_2. It is not necessary to consider the case of the oxides of nitrogen at present, as this branch of the subject will be treated at length in its proper place.

A combination of two or, in some cases, more atoms is called a molecule, H_2O is a molecule of water, NH_3 of ammonia, and CH_4 of marsh gas; and the molecule is defined to be the smallest quantity of a compound or element, which can exist by itself. The atom, the smallest quantity of an element which is known to take part in a reaction, is only known in the combined state* O=16 means oxygen in combination, free oxygen is represented by O_2=32 and O_2 is called its molecule; in like manner H_2=2, Cl_2=71 represent the molecules of hydrogen and chlorine, that is when they are set free from combinations in which they existed; for example in HCl hydrochloric acid, H is an atom of hydrogen, and is equal to I, but if HCl be acted upon by zinc, two atoms of hydrogen are expelled by it from the hydrochloric acid, and from H_2 the molecule of hydrogen, the zinc entering into combination with the chlorine thus—

$$2\,(H\,Cl) + Zn = Zn\,Cl_2 + H_2;$$

but, if instead of zinc, which is divalent, a monovalent metal as sodium be taken, the decomposition should be represented thus—

$$2\,H\,Cl + 2\,Na = 2\,(Na\,Cl + H_2).$$

It would not be correct to take one atom of sodium, for one atom of hydrogen could not re-act, as no less a quantity of hydrogen can exist in the free state than H_2.†

The molecular weight of a compound is made up of the sum of the weights of its atoms. The molecular weight of water, H_2O is 2+16=18, of sulphuric acid, H_2SO_4 2+32+64=98, of nitric acid, HNO_3 1+14+48=63. The molecular weight of anhydrous nitric acid, N_2O_5 is 28+80=108, if to this be added a molecule of water, H_2O, nitric acid is formed—

$$N_2O_5 + H_2O = H_2N_2O_6.$$

* The word element here includes elements proper, and bodies which, though compound, behave as elements, such as cyanogen CN, ammonium NH_4; and the statement cannot apply to elements, where the atom and molecule are identical, as in the case of mercury.

† At the commencement of this article, decompositions are represented, in which only one atom of hydrogen is set free. This is in general an incorrect method of stating such a reaction, it is here used simply to prevent confusion and complication by doubling the molecule.

Why then is not $H_2N_2O_6$ the molecule of nitric acid, and not HNO_3? It is found by experiment that potassium or sodium, which are both mon-equivalent with hydrogen, replace that element in nitric acid in one proportion only, that is, they form but one nitrate KNO_3 and $NaNO_3$, and that no such compound as $KHNO_3$ or $NaHNO_3$ or K_2NO_3 or Na_2NO_3 exists, also that when a divalent element, as baryta, forms a nitrate, its composition is Ba $2(NO_3)$; from which it is concluded that the molecule of nitric acid contains only one atom of hydrogen, and is properly represented by the formula HNO_3. In like manner it is shown that the molecule of oxalic acid has the formula $H_2C_2O_4$, not HCO_3, both the atoms of hydrogen being capable of replacement by potassium or sodium, thus we get KHC_2O_4 and $K_2C_2O_4$; also $NaHC_2O_4$ and $Na_2C_2O_4$. In sulphuric acid, as in oxalic, both the atoms of hydrogen can be replaced by potassium severally or together, as in $KHSO_4$, commonly called bisulphate of potash, and in K_2SO_4 sulphate of potash, or by a divalent element as calcium, forming $CaSO_4$. The number of atoms of hydrogen which can be replaced by other elements, or by compounds which act as elements, determine the *molecular constitution* of a body, and therefore its *molecular weight*. Many of the elements and their compounds exist in the gaseous state, as oxygen and carbonic acid; some can be brought into that state by heat, those which are compounds without decomposition, as mercury and water; some cannot be volatilized at all, as carbon; and others are decomposed when heated, before they are vapourised. All gases, whether elementary or compound, expand equally for equal increase of temperature, for example—hydrogen and water-vapour, when not in contact with water, expand regularly 0.003665 of their bulk for every degree centrigrade rise of temperature; the same amount of pressure equally diminishes their volume; and the elastic force which their particles exert against whatever restrains their efforts to expand, is the same, provided they are at the same temperature and under the same pressure. This fact has been explained by Avogadro, on the supposition that, in equal volumes of gases there is an equal number of molecules. When hydrogen and oxygen combine to form water, two molecules of hydrogen and one of oxygen, at least, must take part in the reaction, H_2, H_2 and O_2, three molecules; and these, after combination form H_2O, H_2O, two molecules. If four litres* of hydrogen be mixed with two litres of oxygen, and the mixture be exploded, the product, in the state of vapour, will measure four litres, six volumes of the mixed gases being condensed to four of

* A litre is equal to 1,760773 English pints.

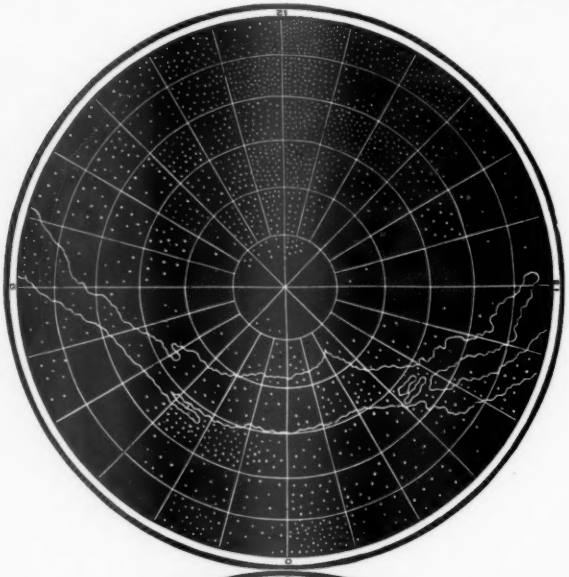
the compound, the condensation in volume being in proportion to the reduction in the number of the molecules. In ammonia, three molecules of hydrogen re-act on one of nitrogen, H_2, H_2, H_2, and N_2, the ammonia formed by their combination is NH_3, NH_3, two molecules; here four molecules have become two, and if measured volumes be taken, for example, six litres of hydrogen, and two of nitrogen, the ammonia gas resulting from their combination will measure four litres. In like manner it can be shown that the same results are obtained where the molecules are of a more complex character. Equal volumes of elements and compounds in the gaseous state, contain an equal number of molecules, and this hypothesis renders it easy to understand how condensation in volume takes place between mixed gases or vapours, when they become chemically combined. The molecules of all chemical compounds, with very few exceptions, occupy, when in the state of vapour, two volumes, that is, they occupy the same volume as the molecule of one of their constituent elements; for example CH_4, marsh gas, occupies two volumes, and hydrogen, one of its constituents, in the free state is H_2, and occupies two volumes. Olefiant gas, C_2H_4, occupies the same volume as H_2, and this is true of the complex molecules of organic bodies. This law of vapour-volumes has assisted in determining the atomic weights of certain elements. For a long time it was doubtful whether the atomic weight of zinc was 65 or half that number. When zinc ethyl was made, and its vapour-volume taken, it was found that ZnC_4H_{10} occupied two volumes, and was therefore its molecule, and that it contained zinc in the proportion of 65 parts of zinc to one of hydrogen, the atomic weight of zinc was therefore fixed at 65. From the fact that the molecule in the state of vapour occupies two volumes, it is easy to arrive at the density of any compound with respect to hydrogen; for if CH_4, in the vapour state, occupies two volumes, and if the molecular weight of a compound is the sum of the atomic weights of the elements composing its molecule; the molecular weight of C H_4 will be C=2, H_4=4 C H_4=12 + 4=16=two volumes. Now the molecule of hydrogen is H_2=2 therefore the molecular weight of marsh gas is to the molecular weight of hydrogen as 2 : 16.

If we now take the atomic weight of hydrogen to be one, the weight of marsh gas compared with hydrogen, or its density, is eight, and in this simple way the density of any compound body may be arrived at, *add together the atomic weights of the constituent elements, and divide their sum by two, the result gives the density required.* In the case of elements, their densities are the same as their atomic

weights, the molecule of hydrogen, H_2, occupies the same volume as the molecule of chlorine, which is Cl_2, that of hydrogen = 2, that of chlorine = 71, and therefore the molecule of hydrogen is to the molecule of chlorine as 2 : 71, and therefore the atom of hydrogen is to the atom of chlorine as 1 : 35·5, which is the atomic weight of chlorine. The same is true of oxygen, nitrogen, and all the other elements with a few exceptions. Some elements, however, combine without condensation of volume. Chlorine, bromine, iodine, and fluorine combine with hydrogen volume for volume, the molecules of the resulting gases, hydrochloric, hydrobromic, hydriodic, and hydrofluoric acids occupying two volumes, and their densities, on the hydrogen scale, are half the sums of the atomic weights comprising their respective molecules; therefore one volume of hydrogen and one of chlorine form two volumes of hydrochloric acid, whose density is $\frac{1 + 35{\cdot}5}{2} = 18{\cdot}25$; one volume of hydrogen and one of bromine form two volumes of hydro-bromic acid, whose density is $\frac{1 + 80}{2} = 40{\cdot}5$; one volume of hydrogen and one of iodine form two volumes of hydriodic acid, whose density is $\frac{1 + 12{\cdot}7}{2} = 64$; and one volume of hydrogen and one of fluorine form two volumes of hydrofluoric acid, whose density is $\frac{1 + 19}{2} = 10$. There are, however, some exceptions to this law, which, for a time, were without explanation. Chloride of ammonium, NH_4Cl, or hydrochlorate of ammonia, NH_3HCl, the same substance differently named, according to the view which is taken of its constitution, was found to occupy four volumes in the state of vapour. The anomaly has been explained in this way: When heated, the chloride breaks up into hydrochloric acid and ammonia, so that the molecule of each of these bodies occupies its own vapour-volume; *i.e.*, two volumes, and they together occupy four volumes; and that when cooled again they enter into combination. This view was not at first generally received. M. Deville performed several experiments to prove that chloride of ammonium is not decomposed by the heat sufficient for its vaporization. He caused hydrochloric acid gas and ammonia to unite, *with evolution of heat*, at a temperature of 350° Cent., the temperature at which the vapour density of chloride of ammonium is four volumes, and from this he argued that if union took place at that temperature, decomposition could not; but M. Lieben showed that decomposition might take place, but not completely,

that, if the products of decomposition remain in contact with the substance which is being decomposed, a small quantity of it remains undecomposed, and he argued that, if the separate gases were mixed at the same temperature, they would remain almost entirely free, only a small quantity uniting, and that this union would be attended with evolution of heat; he therefore concluded that the small quantity of chloride of ammonium formed, could not materially influence the vapour-density determination. Experiments subsequently made by M. Wurtz on other similar compounds, have confirmed M. Lieben's views. Sulphuric acid H_2SO_4 also gives an anomalous vapour-density, its molecule occupying, in the vapour state, four volumes. Here, as in the case of chloride of ammonium, the H_2SO_4 has been found to break up into water H_2O, and a hydrous sulphuric acid SO_3, each molecule occupying its proper two volumes. When, however, chloride of ammonium and sulphuric acid are heated to a temperature below that at which they decompose, their molecules respectively occupy two volumes. There are other substances which give anomalous vapour-volumes, nitric oxide N_2O_2 = four volumes, and peroxide of nitrogen N_2O_4 = four volumes; this latter compound has however been found to occupy two volumes when its density has been taken at a lower temperature. Among the elements, phosphorus, arsenic, and mercury show some irregularities. The atomic weight of phosphorus is thirty-one, and four of its atoms, in a state of vapour, occupy two volumes, its density therefore, is double its atomic weight, viz., sixty-two. Arsenic has an atomic weight seventy-five, and its molecule contains four atoms in the state of vapour, its density, therefore, is 150. The atomic weight of mercury is found to be 200, and Hg = 200 = two volumes; therefore the atom and the molecule are the same, and the vapour density of mercury is 100. If it were not for these exceptions, the vapour-volume of any molecule would be a perfect confirmation of its molecular weight; as it is, the molecular weights of all compounds whose vapour-densities obey the general law, may be relied upon as being perfectly accurate.

FIG. 1.—ILLUSTRATING THE DISTRIBUTION OF THE NORTHERN NEBULÆ.



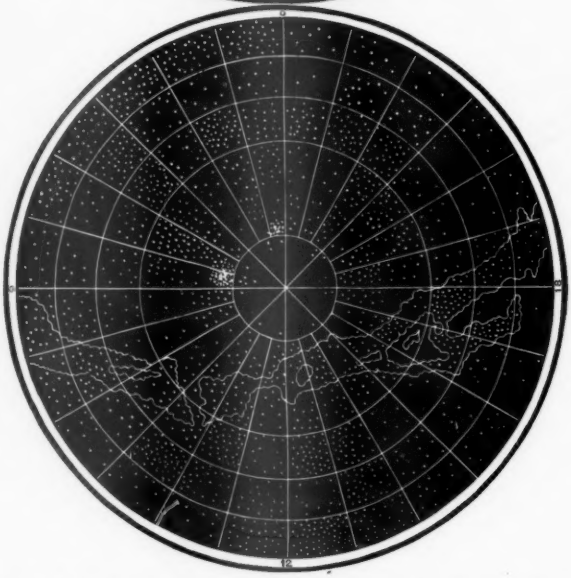


FIG. 2.—ILLUSTRATING THE DISTRIBUTION OF THE SOUTHERN NEBULÆ.

NOTES ON NEBULÆ.

BY RICHARD A. PROCTOR, B.A., F.R.A.S.

(With a Tinted Plate.)

INCLUDING both hemispheres, there are visible to the naked eye, under the most favourable circumstances, about 5000, or at the most 6000 fixed stars. If these and the fixed stars visible in the most powerful telescopes were to disappear, and the eye to acquire the light-gathering power of Herschel's 20-feet reflector, there would be seen scattered over the vault of heaven—instead of the fixed stars now visible—about as many nebulæ—"feebly shining, cloud-like patches, often of strange and fantastic forms."

The faint illumination of nebulæ, the close crowding of stars in many that are resolvable, and other circumstances, have appeared to confirm the view that these objects shine from distances far beyond those of the farthest fixed stars. It has been considered that nebulæ are (for the most part, at least) aggregations of suns ("island-universes," as a German philosopher has expressively termed them), forming galaxies similar to our own "Milky Way," and reduced, notwithstanding the immensity of their dimensions, by a yet greater immensity of distance, to the appearance of faint specks of light, which the slightest haze in our skies is sufficient to conceal from us. The important discoveries effected by Mr. Huggins, which have shown that many nebulæ are gaseous in composition—nineteen out of sixty observed presenting the spectrum of bright lines separated by dark spaces which indicates the gaseity of the source of light—have modified these views. Without giving absolute support to the speculations of Sir W. Herschel, respecting the condition and changes of condition of nebulæ, Huggins' discoveries show that the views on which Herschel founded his speculations were well grounded. The distinctions Herschel drew between the different classes of nebulæ have been confirmed, so far as spectrum analysis has yet proceeded—every planetary nebula yet observed, for instance, has been proved to be gaseous. The process of generalization, which had been commenced by many eminent astronomers, and in which scarcely any distinctions but those depending on the resolvability of nebulæ were recognized, has been abruptly checked. It is to be noticed, however, that many German astronomers, and some, at least, of our most distinguished English

observers (amongst others, the late Admiral Smyth) had looked with more than doubt on the view that, with sufficient optical power, all nebulæ are resolvable into stars.

It is clear that Huggins' discoveries affect, not merely the views we must form of the constitution of nebulæ, but our ideas of the distances at which these objects are placed, and, therefore, of their true magnitudes. It is with such considerations as are suggested by modern discoveries, and with others for which the overthrow of opinions lately thought well-established seems to leave room, that I wish now to deal. Anything like a discussion of the *general* subject of nebulæ, a sketch, however brief, of the history of their discovery, or an account of particular nebulæ (save in illustration of the considerations I have to deal with), would be wholly out of place in these pages—especially since the readers of the INTELLECTUAL OBSERVER received, in many papers of interest, full information on these and kindred branches of the subject.

The first point I shall dwell upon is the distribution of nebulæ over the heavens. In the present state of our knowledge, it would not be convenient to particularize classes of nebulæ in considering this point—though, as we shall presently see, there are one or two circumstances in this connection which cannot be wholly neglected.

Sir John Herschel, in order to form a clear conception of the distribution of nebulæ over the celestial sphere, adopted a plan similar to that illustrated in Figs. 1 and 2 (see plate). But he represented the number of nebulæ falling in each space by numbers —a method which does not serve to present very clearly the distribution of nebulæ. In Figs. 1 and 2, I have indicated the number of nebulæ falling in each space by dotting. Let us consider what evidence the maps seem to present of orderly distribution.

In Fig. 1, there will be observed a very decided clustering in the region between 11h. and 14h. of R.A. This is the nebular region in Virgo, extending over Coma Berenices, and the tail of Leo, curving (to the right in our figure) over Canes Venatici, thence (to the left) over the tail and hind quarters of Ursa Major, to within about 12° of the pole near the tail of Draco. The borders of this stream or cluster of nebulæ extend dispersedly over the two Leones, Cancer, Gemini, Lynx, and Ursa Major on one side (the left in our figure), and over Bootes and Corona on the other. As there seems to be a decided break in the stream—or rather, perhaps, as the stream decidedly comes to an end near the pole—we must return to the point from which we commenced, the upper part of Fig. 1; and thence, to look for the continuance of the stream in the

contrary direction, we must look to the lowest point of Fig. 2.* Here we find a continuation of the stream, which presently divides into two, the right hand stream passing over the left hand of Virgo, the tail of Hydra, and nearly the whole extent of Centaurus, to Crux and Musca; the left-hand stream passing over Crater, to Antlia, and the mast and sails of Argo. The gap which bounds the northern group seems continued, but not in quite so marked a manner, by the space comparatively clear of nebulæ which runs round the right-hand stream (of the two just described) across the pole, and thence to a point a little above the extreme left of Fig. 2. Returning to Fig. 1, we notice a less distinctly marked grouping over part of Perseus and Andromeda, passing (to the right) over the square in Pegasus to the southernmost of Pisces, and (to the left) over the band in Pisces, across Cetus (in the upper left-hand quadrant of Fig. 2), Eridanus, and Dorado, in a distinctly-marked stream leading to the Nubecula Major. The right-hand stream, which we had followed as far as Pisces, seems to have a continuation towards the Nubecula Minor, and also to throw out a convolution over the tail of Piscis Australis, over Indus et Pavo, towards Apus and Musca.

There remains to be noticed a clustering of nebulæ towards the right hand portion of the Milky Way in Fig. 2. Sir John Herschel considers that many of these nebulæ belong to the Milky Way, as they are wanting in the gap between the two branches of the galaxy in this neighbourhood.

The first inquiry which suggests itself, on a review of the distribution of nebulæ, is the question, whether there is any indication of a connection between nebulæ and fixed stars? The theory that nebulæ are galaxies similar to our own Milky Way would, of course, require that we should dissociate nebulæ from any connection with our galaxy, save a relation corresponding to that which holds between the fixed stars and the sun. And further, although it would not be impossible that a tendency to systematic arrangement should be apparent among the nebulæ, yet the distances separating nebula from nebula would (on this theory) be so vast, compared with the distances separating star from star, or even with the dimensions of our galaxy, that it would clearly be very improbable that such

* There is a slight inaccuracy in Sir J. Herschel's maps. The southern map is correctly presented, but in the northern the order of R.A.'s is inverted. This renders the comparison of the map with a celestial atlas inconvenient. Figs. 1 and 2 are so arranged that, if closed one upon the other, the corresponding parts of the circumference of each would be brought together.

arrangement should be discernible by terrestrial astronomers. As, however, the theory is very generally held, I shall present, as I proceed, some considerations which seem opposed to it. We seem, rather, to have evidence that most of the nebulæ—if not all of them—are much nearer to us than has been commonly maintained. I must observe, however, that my object is neither to establish nor to overthrow theories, but merely to note some of the salient points of the subject in hand, which have, as it seems to me, been unduly neglected in our works on Popular Astronomy.

Sir J. Herschel, after presenting the chief features of the distribution of nebulæ, remarks that "the general conclusion which may be drawn from the survey is, that the nebulous system is distinct from the sidereal, though involving, and, perhaps, to a certain extent, intermixed with the latter." Setting aside the "band of clusters" near Scorpio, already referred to, he considers that the distribution of nebulæ is explained by considering the nebular region in Virgo to be the central condensation of a spherical (roughly speaking) cluster of nebulæ; that our system lies outside the denser part of the cluster, but is "involved within its outlying members," or "forms an element of some one of its protuberances or branches, of which the individuals are the sporadic nebulæ confusedly scattered over the general surface of the heavens, and of which the prolongation towards the constellation Pisces may give rise to the apparently denser grouping of the nebulæ in that region."

To me these views appear wholly untenable, and I feel the less diffidence in expressing dissent from so high an authority as Sir J. Herschel, because he has elsewhere expressed opinions which show that he held the above theory by but a light grasp. If the dense mass of a cluster of nebulæ lay in one direction, and but outlying branches in the other, the number of nebulæ seen in the former direction should overwhelmingly exceed the number seen in the other; whereas, at the outside, the proportion in the actual case is but as two to one, and even this excess is no doubt partly due to the fact that the southern hemisphere has been less thoroughly searched than the northern. And neither this view, nor the other solution suggested by Herschel, explains the existence of a zone of the celestial hemisphere in which nebulæ are markedly wanting. If our system were placed within a *narrow* branch, or protuberance, of a nebular system, the cluster in Cetus should be smaller than it is; if, on the other hand, the branch were of such dimensions as our conception of the distances of nebulæ would lead us to expect,

there would not be wanting nebulæ on every side of us. These, however, are not the objections on which I would mainly dwell. I shall be able to show, I think, that the appearance of nebulæ, and the relations they present to the fixed stars, are opposed to the view that they form an independent system, of which our galaxy is but a member.

Singularly enough, Sir J. Herschel immediately after exhibiting the views presented above, quotes (and as if in corroboration) an opinion of his father's, which is very strongly opposed to those views. He says, "It must not be left out of consideration, and has been distinctly remarked by Sir W. Herschel, as an element of whatever speculation a closer attention to this subject, and a more perfect classification of nebular objects may lead us to indulge in, that the most condensed portion, and what may fairly be regarded as the principal nucleus of the region of Virgo, is situated almost precisely in one pole of the Milky Way." Why, it may be asked, should the nebulæ, supposing they really form a system of which our galaxy is but a member, show any tendency to aggregation about either pole of the Milky Way? Assuming our galaxy to be but a member of a supposed nebulous system, to *expect* any relation of the kind described would be as unreasonable as it would be for an astronomer on Saturn to look for a connection between the arrangement of the fixed stars, and the apparent position of the Saturnian rings upon the celestial firmament. And therefore, if such an arrangement is actually observed, it must be accepted either as accidental—in which case it is clearly not necessary to consider it in forming a theory of the nebulæ; or else we must view the arrangement as an evidence of a closer connection between the nebular system and the Milky Way than is commonly assumed to exist.

Tracing the group or stream whose condensed region is in Virgo from its commencement near the tail of Draco, we find that it crosses a region rich in small stars and double stars. Coma Berenices, a constellation which may almost be termed a star-cluster, is rich in nebulæ. But Ursa Major, a region of the heavens of exactly opposite character—a region in which many brilliant stars shine on a background which in places appears (to me at least) of unusual blackness—includes also a rich part of the nebular stream. Leo Minor exhibits several small stars, but in this constellation nebulæ are rich where small stars (fourth magnitude) are wanting. In this neighbourhood the background may almost be termed nebulous. The rich nebular cluster in Virgo lies on that part of

the constellation which borders on Coma Berenices. The region is surrounded on every hand by stars of the third and fourth magnitude, but over the region itself stars are rather markedly absent. Crossing the equator, we find that the stream shows a decided preference for regions in which visible stars are scarce. Thus over Corvus and Crater, where lucid stars are closely clustered, there is a gap in the nebular stream, and the rich cluster near the break in the Milky Way occupies the blank region mentioned in my paper on star-streams in the INTELLECTUAL OBSERVER—a region than which there is none more desolate (so far as lucid stars are concerned) in the whole heavens. The neighbouring region, crossed by the brightest part of the Milky Way, and by a brilliant array of lucid stars, exhibits but few nebulæ.

Turning to the less-marked nebular cluster, whose greatest condensation is in Cetus, we find in its northern part a rich display of nebulæ over parts of Perseus and Andromeda, in (or around) which lucid stars are thickly clustered. Near the equator (on the southern side) we find nebulæ distributed richly over a region in which are many stars of all magnitudes, including many double-stars, and one noted variable. Of the two streams into which the nebular system here divides, one follows the windings of Eridanus, with an apparent preference for the spaces clear of stars, around which that star-stream travels; the other forms itself into a cluster which occupies a space almost as blank of lucid stars as that between Hydra and the Milky Way.

When we consider those regions of the heavens in which nebulæ are markedly deficient, we find an arrangement which cannot be wholly accidental. I refer to the zone, very marked in the northern hemisphere, and not indistinctly traceable in the southern, which has been already described. This zone is not quite coincident, in direction, with the Milky Way, but follows almost exactly a circular band, which includes more lucid stars than any corresponding band on the heavens. In fact, if we neglect nebulæ, which may fairly be considered to belong to the Milky Way itself, we may fairly say that the zone includes Canis Major, Orion, Taurus, Auriga, Perseus, Cassiopeia, the richer parts of Cepheus and Draco, Lyra, Scorpio, and finally, the rich region in Argo already mentioned.

Now, it appears to me that those who have speculated on the subject of nebulæ have been too apt to content themselves by looking for zones and streams of aggregation, not noticing apparently that zones along which nebulæ are sparingly dis-

tributed, may be as marked indications of systematic distribution as zones of aggregation. I consider that the zone mentioned in the preceding paragraph is a phenomenon scarcely less distinct in character than the zone of the Milky Way itself; and I look on the connection between the former zone and the zone of brilliant stars as a very noteworthy circumstance.

I may remark in this connection that much less stress has been laid on the peculiarity that scarcely a single lucid star occurs within the gaps and cavities in the Milky Way than the nature of the phenomenon fairly warrants. While stars are clustered in the borders of these spaces, *within* there is such a vacancy that one cavity is called the Coalsack, another is called by Sir W. Herschel an opening into space, and Sir John Herschel, speaking of the vacant region near α Centauri, tells us that in his powerful telescope he found several fields wholly blank. There is not a single star of greater magnitude than the fifth within a cavity in the Milky Way, or between the two streams where the galaxy is double; and there are not ten stars of the fifth magnitude so situated. This will appear the more remarkable when we remember that, according to the stratum theory of the Milky Way, these regions ought to be very rich in stars of all magnitudes.

It has been already noted by astronomers that all nebulæ of irregular form and great extent are found along a zone nearly coinciding in direction with the Milky Way. The great circle along which such nebulæ are actually found is, in fact, no other than that along which nebulæ in general are conspicuously wanting. It is also worth noticing that where this zone, and the zone of the Milky Way intersect, we find the singular nebula round η Argus in one hemisphere, and in the other the remarkable nebular region in Cygnus.

The discovery that the great irregular nebula in Orion is gaseous, renders it probable that the other irregular nebulæ are so likewise. Whether they are so or not, it is clear that they are totally different in character from regular nebulæ. Therefore, we may look on their aggregation on the great circle along which few nebulæ are found, as a circumstance (1) not opposed to the evidence of systematic distribution founded on that peculiarity; (2) as itself indicative of arrangement associating nebulæ with the stellar system.

One peculiarity of the irregular nebulæ deserves to be especially dwelt upon. All of them exhibit a tendency to arrange themselves around fixed stars. Consider, first, the nebula in Argo.

In the first place, there is the actual aggregation of stars near the very region of the nebula—a fact which is *per se* remarkable, though not alone sufficient to indicate the connection I am seeking to exhibit. "It is not easy," says Sir J. Herschel, "for language to convey a full impression of the beauty and sublimity of the spectacle which this nebula offers, as it enters the field of view of a telescope fixed in Right Ascension, by the diurnal motion, ushered in as it is by so glorious and innumerable a procession of bright stars *to which it forms a sort of climax.*" "*One other bright and very remarkably formed nebula of considerable magnitude precedes it nearly on the same parallel, but without any traceable connection between them.*" I have italicized this last quotation, (1) because it points to a phenomenon observed in all the irregular nebulæ, of associated but not always distinctly connected nebulæ; (2) because the association of *two* irregular nebulæ with the same stream of bright stars is well worthy of attentive notice.

But it is when we examine the features of the nebula that its association with the starry background becomes most clearly apparent. In the small map of the nebula given in Herschel's Astronomy the relation is not satisfactorily presented, but in the large map of which the former is a reduction, we find the following peculiarities:—

The central and most condensed part of the nebula exhibits a vacuity of singular, but regular form, described by Herschel as a lemniscate-oval, but in reality more complex than this description implies. The brilliancy of the nebulæ is much greater on one side of this vacuity than on the other. In the middle of the bright region is situate the remarkable variable η Argus—a star marked in Halley's Catalogue as of the fourth magnitude, but which has been known to surpass Canopus, and even to approach Sirius in magnitude. Around the vacuity there are marked in no less than twelve stars either exactly on, or very close to the border. One of these is just within the vacuity; but besides this star, which may fairly be termed a border-star, there is not a single star within the opening. On the other hand there may be counted, besides the twelve stars above named, no less than fifty-four stars on the nebulous region around the opening. From the central part of the nebula, there extend a number of nebulous streams, "of whose capricious forms and irregular gradations it would be impossible to give any just idea." But one peculiarity is noticeable throughout the convolutions and contortions of these irregular streams—viz., that *on* the nebulous portions stars are common, on the parts *clear*

of nebula stars are either wholly wanting or very sparingly distributed. And those stars which do occur in apparently blank regions, yet appear evidently associated with nebulous streams and projections pointing directly towards them. The connection is so marked, that I cannot understand how it can have escaped the notice of so sagacious an observer as Herschel; or rather how noticing the phenomenon, he should not have recognized the evidence it afforded of a connection between the nebula and the fixed stars seen in the same field. There is not a single remarkable condensation or projection in the nebula which is not marked by bright or clustering stars, by stars which appear clearly to be *leading stars*, and there are not ten stars out of some hundreds entered, whose influence on the nebula is not clearly discernible. If the fainter portions of the nebula were examined with more powerful telescopes, I believe that even these stars would be found to be associated with the nebula.

As respects the great nebula in Orion, I remark that while the proportion of stars whose connection with the nebula has not been traced is somewhat greater, yet nearly every marked condensation in the nebula is associated with conspicuous stars (that is, with stars conspicuous among those visible in the same field of view with the nebula). Every telescopist also is familiar with the fact, that the central condensation of the nebula clusters round the trapezium of stars, within which there is either no nebulous light or very little. The association is not likely to be an accidental one. Herschel himself remarks that the star ϵ Orionis is involved in strong nebulosity, "probably connected with the great nebula," while he was able to trace a faint extension of the nebula as far as the double star ι Orionis, which it involves and renders nebulous.

Turn we now to the region of irregular nebulæ of Sagittarius. The first nebula mentioned by Sir J. Herschel is described by him as "singularly trifid, consisting of three bright and irregularly formed nebulous masses, graduating away insensibly externally, but coming up to a great intensity of light at their interior edges, where they enclose and surround a sort of three-forked rift, or vacant area, abruptly and uncouthly crooked, and quite void of nebulous light. A beautiful triple star is situated *precisely* on the edge of one of these nebulous masses, just where the interior vacancy forks out into two channels. A fourth nebulous mass spreads like a fan or downy plume *from a star*, at a little distance from the triple nebula." Another (δ Messier), he describes as "a collection of nebulous folds and masses, surrounding and

including a number of oval dark vacancies, and in one place coming up to so great a degree of brightness, as to offer the appearance of an elongated nucleus. *Superposed upon this nebula, and extending in one direction beyond its area, is a fine and rich cluster of scattered stars, which seem to have no connection with it, as the nebula does not, as in the region of Orion, show any tendency to congregate about the stars.*" Herschel gives a view, however, of the nebula and star-cluster which, it is not too much to say, is wholly irreconcilable with the opinions here expressed. Not only are the two brightest stars of the cluster placed exactly upon the "elongated nucleus," but every "fold and mass" of the nebula is associated with a region of greater richness in the cluster.

As respects the fourth and last nebula, that of Cygnus, I may simply quote Sir J. Herschel. He describes the region as "consisting, first, of a long, narrow, curved, and forked streak, and, secondly, of a cellular effusion of great extent, *in which the nebula occurs intermixed with, and adhering to, stars around the borders of the cells, while their interior is free from nebula, and almost so from stars.*"

I have already drawn out this paper to a much greater length than I had proposed, and yet have seemed scarcely to have entered upon my subject. Let me, instead of proceeding to treat cursorily of the remaining branches of that subject, here pause and "report progress." We have found a law of aggregation of nebulæ in regions removed from the Milky Way, and thus a law of contrast, which amounts in reality to a law of connection between nebulæ and the starry system. We have found that, in the southern hemisphere, this law of contrast is further exhibited in an aggregation of nebulæ over regions in which stars are wanting, and *vice versâ;* lastly, we have seen that over a *zone* of the heavens in which nebulæ are all but absolutely wanting, there is a marked aggregation of lucid stars, that on the same zone all the irregular nebulæ are collected, and that these irregular nebulæ, all occurring in regions very richly bestrewn with fixed stars, exhibit in their configuration a correspondence with the configuration of the fixed stars in the same field, which cannot be wholly accidental.

WHITE'S MASSACRE OF ST. BARTHOLOMEW.*

THE Massacre of St. Bartholomew, though well known as one of the most fearful tragedies which history records, is rarely contemplated from a philosophical point of view. Amongst Protestants it is usually regarded as an awful illustration of the persecuting spirit of the Romish church, and little attention is paid to its political character, or to the long series of circumstances, social and political, as well as theological, by which it was brought about. It is curious to note how a particular incident of this kind occupies a position in the thoughts of a Protestant country like England, almost to the exclusion of many similar incidents of equal atrocity and of more sanguinary extent. The French massacre was exceeded in deliberate wickedness and surpassed in magnitude by the atrocities of the Duke of Alva in the Low Countries, but yet millions reflect with horror upon the St. Bartholomew slaughter, while only scores or hundreds thought much about the sufferings of the Dutch and the Flemings till Motley took up their tale. The Thirty Years' War in Germany, again, was one continued massacre on the Papal side, in which the worst incidents of St. Bartholomew were frequently rivalled or exceeded; but, though Germans still stand aghast at the destructive ferocity of carnage-loving Tilly, in English eyes he is eclipsed by the guilt of Catherine de Medici and Charles IX.

There is, after all, some rude justice in the way in which St. Bartholomew's Day is thus exalted in horror by the Protestantism of our country, for it was doubtless a day of tremendous importance for France and for the cause of the Reformation in that land. Though supported by a powerful party at the time of the massacre, the Protestant cause in France could not afford the loss of so many of its bravest spirits and leading minds. But for that day of too-successful assassination, Henry of Navarre might not have found himself compelled to submit to conversion as the only means which appeared open to him of restoring peace to France, and, but for that day, another day of evil for our neighbours, that on which the Edict of Nantes was revoked, might never have cast its blighting influence upon them, and indirectly led to the substitution of tempestuous revolution for the quiet development of reform. In every age and country there are a few persons who stand in so peculiar a

* "The Massacre of St. Bartholomew, preceded by a History of the Religious Wars in the Reign of Charles IX." By Henry White. Murray.

relation to its progress, that if they are swept away retrogression takes place; and, although the Roman Catholic community of France has never failed to supply great and good men, it is not too much to say that the slaughter of Protestants at one period, and their expulsion at another, threw the country backwards, and left it in a condition which entailed struggles and disasters which the present Empire is evidently not destined to end.

Charles IX. and Catherine de Medici are commonly accepted as types of cruelty and fraud, and yet, when their history is more fairly surveyed, it might almost tempt some daring and whitewashing historian to claim for them no small amount of sympathy, and remove a load of obloquy from their names. Dr. White has not attempted this task, and we are glad of it, for, though he might have made out as plausible a case as other writers have done on behalf of equally damaged reputations, the result would not be nearer the truth than the black picture which popular imagination delights to paint.

Individual guilt must depend upon circumstances of which men can very imperfectly judge. There are thousands of ordinarily good people who would behave very badly if placed in situations offering strong inducements to go wrong, and slender guidance to act right. Catherine and her son had no bigotted hatred of the Reformed faith. They were not cruel in the ordinary sense of the word—that is, not more so than was customary in an age when bloodshed was incessant, punishments ferocious, and suffering so common as to attract little heed. There were periods in the career of both when, if the political conditions under which they ruled had been more favourable, they would probably have either established Protestantism as a state religion, or secured for it full toleration; and, had they done so, their names might have gone down to posterity as amongst the most excellent specimens of their class, though they would only have acted upon the same class of motives which, under unfavourable circumstances, steeped them in crime.

The merit of Dr. White's book consists in its almost mathematical fairness, as well as in the success with which he has availed himself of recently accessible materials. He depicts circumstances and events with a sound perception of their relative importance, and with rare impartiality. He never philosophizes, but arranges his materials with philosophical precision, and as we follow his narrative, we feel the inevitableness of the catastrophe more than the personal guilt of the actors in it, who appear, as they probably

really were, the instruments of destiny rather than the rulers of events. In such destiny there is no blind fatality, but an inexorable law, by which selfishness, ambition, and falsehood, acting at a period when moral and social counter-checks were inefficient, when political ties were loosened, and passions riotous, necessarily led to terrible and calamitous results.

Some historians write as if all the important incidents and characters of an age were the consequences and appendages to a central personage whom they elevate into a fabulous hero. Much of this may be traced in Carlyle, and it abounds in the melodramatic but philosophically worthless efforts of Charles Kingsley. Dr. White is no hero-maker, and he lacks the dramatic power which is necessary to give a strong personal reality to his characters. He does little to stir our moral nature: we do not care very much for Coligny and the other Protestant leaders as he depicts them, nor do we very strongly hate the Guises, or Charles, or Catherine. This result may disappoint many readers; but though we think the story might have been told with equal truth, and with a more stirring appeal to human sympathies, we recognize the value of the level tone which he adopts; and when an author of merit gives us a really good book, we think it ungenerous as well as unfair to criticize it upon the principles of a school to which it was not intended to have any affinity.

To show how Dr. White enables us to appreciate the times in which his scene is laid, we shall advert to a few of the facts he brings forward. He describes France in the middle of the sixteenth century as a monarchy only in name, when, as was usually the case, the king had not enough talent and vigour to maintain his own power. The nobles, he tells us, looked upon the sovereign as little more than the first among peers; and "when Montluc summoned the mutinous nobles of the south to return to their allegiance, and obey the king, they exclaimed, 'What king? We are king. The one you speak of is a baby king; we will give him the rod, and show him how to earn his living like other people.'" The precarious and feeble condition of the crown was a natural result of the general state of the country, which was "divided into numerous provinces, partially independent, under their own governors and parliaments, and with hardly more sympathy between them than there is now between Belgium and Holland. In almost every province you heard a separate dialect; the Normans and the Gascons were mutually unintelligible, and the inhabitant of Brittany had as little in common with the dweller in Languedoc as the

Sussex boor with his fellow-labourer in Picardy." The modern French passion for centralization did not exist even in a rudimentary form; all parties seemed impatient of central control. "The provincial parliaments registered or rejected the king's decree at their pleasure, and the taxes were levied by order of their own estates: self-government in form more than in reality."

Locomotion was difficult and dangerous; large forests sheltered the wild boar, the wolf, and the still more dangerous brigand; and districts separated by a few miles of roadless and trackless country enjoyed no intercourse, so that one might be starving in famine while the other possessed abundance. "It took eight days to carry the news of the Bartholomew massacre to Toulouse, along one of the best roads in France." Under such circumstances there could be little public opinion, though notorious and conspicuous characters might be popular or the reverse. The rural population was in a wretched state; the peasants built their huts in the hollows and valleys, as far as possible removed from the routes of the brigands who composed the armies of those days." Taxation was unequal and oppressive. "Rent was usually paid in kind or in service. If in kind, it was a certain share of the produce, which in Brittany was a twelfth." Money rents were commencing, and feudalism very slowly passing away—so slowly, that at a late date, only "two years before the outbreak of the Revolution, the serfs of twenty-three communities belonging to the Abbey of Luxeul refused to be emancipated, choosing rather to remain as they were, than pay the moderate fine required for their enfranchisement." Wages were low, "the labouring man receiving twelve deniers a day, and a woman six," when a dozen eggs cost eight deniers, a bushel of turnips four deniers, a fowl from two to six sols, a calf five livres, a sheep twenty-four sols, a fat pig three livres, and an ox, three or four years old, ten livres. The common food of the peasantry was unleavened black bread; the usual meat was pork, and as this diet was supposed favourable to leprosy, officials were appointed to look at the pigs' tongues for leprosy spots. "The odious gabelle made salt so dear, that the farmer had often to sell one half of a pig to procure the means of pickling the other half." The clergy possessed enormous wealth, and were for the most part extremely ignorant, so that Montluc, Bishop of Valence, declared, in a sermon preached in 1559, that eight out of ten priests could not read. But if not learned, they were quarrelsome, and required edicts to prevent their using abusive language in the pulpit. Superstition in its most violent form naturally belonged to such a time. To eat

meat on Friday was a deadly sin. Clement Marot narrowly escaped burning for having eaten pork in Lent; and at Angers, in 1539, impenitent Friday flesh-eaters were consigned to the stake, while the penitent were let off with the milder punishment of hanging.

Such a society was in a state of perpetual violence and bloodshed. Even in Paris and other great towns, order was very imperfectly kept, and life was far from secure; and people of all ranks were accustomed to witness and take part in deeds of cruelty and ferocity. Good faith had little existence in public life. Francis I., whom it is the fashion to compliment as a chivalrous sovereign, was neither honest nor veracious. Philip II. habitually employed, and tried to employ, assassination as a tool of statecraft; and if two political factions or families struggled for power, no scruple existed as to the means which they might use. Coarseness and licentiousness were the common characteristics of the men and women of rank and fashion; and when religious differences and difficulties supervened upon such social and political conditions, the confusion became worse confounded, and the fight for existence or for domination more severe.

It may be asked, were the times really so bad? were there no redeeming features, no fine characters, no real learning, no political wisdom, no decency and grace? and the answer must be that such elements existed in far greater proportion than might appear possible under the circumstances, but not in sufficient quantity and force to overcome the mass of evil or direct the progress of events. We are not tracing the happy development of a great country, but considering the circumstances that led to an appalling massacre, and ultimately to a tremendous Revolution, of which the chapters are not yet closed. If the political state of France had been more settled there would not have been the same play for faction, the same tendencies to regal weakness and regal jealousy, and then counsellors like the famous Chancellor L'Hopital—one of the best and most enlightened men of his age—on the Roman Catholic side, might have coalesced or co-operated with men like Coligny and Andelot, on the Protestant side, to secure mutual toleration and freedom of opinion so far as it could have been understood at such a period.

It was unfortunate for the cause of the Reformation in France that Calvin, not Luther, influenced its spirit. The logical dialectic mind and unsympathetic character of the Genevan Reformer did not enable him to adapt his system to an excitable, passionate,

and ignorant population, and the church organization which he established alarmed the ruling powers more than his slavish doctrines of obedience to them effected a conciliation. No monarch of those days could bear the notion of an independent church, and Calvinistic Protestantism did not offer the means of improving and reconstructing what existed; it aimed at the establishment of something new, and for which the bulk of the people were not prepared. Another difficulty which impeded the Protestant cause was the violence of many of its advocates. Their reforming zeal did not always take the shape of argument and exhortation, but was frequently exhibited in sacking monasteries and convents, assailing churches, image breaking, and murdering their opponents, in imitation of the brutalities inflicted by the Romish party upon their predecessors or upon themselves.

When Charles IX. became king he was only ten years old, and Catherine found herself surrounded by dangers and difficulties. She had no real love for France, but much ambition for herself and her children, and she was confronted by the Guises in whom the same qualities of selfishness and ambition predominated. Her first acts showed moderation and a leaning towards the Protestants, and had they been strong enough to have secured her personal power as the reward of her toleration, she would have no doubt acted steadily with them. One of the first proceedings of her regency was to cause the summoning of the States General at Orleans. This assembly consisted of clergy, nobles, and the *Tiers Etat*, or plebeians. The three first met together, and then sat in separate conclaves. The business was opened by the Chancellor L'Hopital, in a speech in which liberal ideas were strangely mixed with narrow views. His political dictum was that the States might petition, but must obey; and when he spoke of religious disputes, he observed that "the sword was of little avail against the understanding," and that "gentleness would make more converts than violence." After which he said it was "foolish to look for peace between two persons of separate creeds." "An Englishman and a Frenchman may live together on good terms, but not two people of different religions who live in the same city." In this unfortunate utterance he was probably guided by the facts he had observed, and did not perceive that a society was possible in which religionists the most opposed in doctrine might agree willingly or unwillingly that law should be supreme. The times, in fact, were too lawless for such an idea to be familiar or easy, and the Frenchman of to-day suffers under the evils and demoralization of despotism because political

parties have remained in the condition which L'Hopital describes as belonging to the religious parties of his time.

After the Three Estates had held their separate meetings, and chosen their "Speakers," they assembled together again on Jan. 1, 1561. Jean Lange, the Speaker of the *Tiers Etat*, denounced "the three ruling passions of the clergy—ignorance, avarice, and wantonness." The Speaker of the nobles complained that the clergy encroached upon the powers of judicial tribunals, and the Speaker of the clergy demanded that proceedings should be taken against all who demanded freedom of worship. In a very different spirit spoke the Abbot of Bois-Aubry, the secretary of the clergy in the preparation of their *cahier*. He discountenanced the employment of the sword or the gibbet, and the assembly of Council. He said the Pope tolerated the Jews, and they were allowed to exercise their religion at Rome and in Avignon, and "could he say that the religion of the Jews, who do not believe in Christ, is better than the religion of those who believe in Him?"

The Estates separated without settling anything, and made the grave political mistake of refusing to take into their hands the power of the purse, on the plea that their instructions did not relate to taxation and supplies. Serious riots between the two religious parties then occurred, and atrocities were committed on both sides, which tended to show L'Hopital's view of the matter was not so far wrong. Catherine again showed a tolerant spirit, liberating imprisoned Protestants, and ordering property to be restored which had been alienated for heresy, and letters patent were issued, commanding the two parties to cease from quarrelling. This was ordered to be read in all churches, and "a Cordelier at Provence introduced it in the following grotesque terms:—'My dear Christian brethren,—I have received instruction to read an edict, ordering cats and mice to live in peace together, and that we in France—that is to say, the heretics and the Catholics—should do the same, such is the king's pleasure. I am sorry for it, and I am grieved to see the new reign begin so unpromisingly.'" Paris, then, instead of being a stronghold of liberal opinions, was quite the reverse, and the Parliament of that city refused to register the edict. It contained very little in favour of the Huguenot party, and was in some points against them.

Dr. White thinks that if Catherine had been a woman of good principles, the current of French history might have been changed at this time; but it needed more than good principles to fight against the Guise party, and the other factions working on the

Popish side, which was powerfully sustained by Philip II., and by most of the great soldiers of the time. Except in Sweden, Germany, and in the Low Countries, no military leader on the Protestant side equalled in skill and tactics the best generals of the opposite party. In the fighting in France which preceded the Massacre of St. Bartholomew, military genius was rarely displayed by the Protestant leaders; and later, when Henry IV. commanded, he threw away again and again his best chances of success, partly from want of skill, and still more from the licentiousness which sent him to his mistresses, when he ought to have exerted all his energies to reap the fruits of the victories he had won. Alexander Farnese, when ill and dying, twice out-generalled him in a manner which marked the difference between the great commander and the brave *sabreur*.

While the two parties were scheming for the gratification of their personal ambition, the States of Pontoise assembled, and L'Hopital, who had thought better of the matter, asked if fellow-citizens of different opinions could not live together in harmony? He opposed edicts against the new religion, and asked if "it were not possible for a man to be a good subject without being a Catholic or even a Christian?" Similar sentiments were uttered by the orator of the *Tiers-Etat*. Catherine had sagacity enough to understand the case, and though superstitious, she was not a bigot. She directed Cardinal Ferrara to inform the Pope that the number of persons professing the reformed religion was great, that they were neither Anabaptists nor libertines, that they believed the Apostles' creed, and that many thought they ought not to be cut off from communion with the Church. She also asked what danger could there be in removing images from the churches, doing away with useless forms, and celebrating divine worship in the vulgar tongue? The question of Catherine's sincerity in these expressions has been discussed with different results; but what is meant by sincerity when applied to a woman of her character? That she could be deliberately false, no one doubts; but she was incapable of equally deliberate truth. Probably she meant what she said at this moment, but the self-interest of a low ambition seems to have been her ruling motive, and if sincerity involves the notion of fidelity to any fixed principle, she had none of it. Of course, the Pope would not make the concessions required. An eternal *non possumus* is the condition of the Papacy. A reformed Pope would have been an abolished Pope, then as now.

Passing rapidly over some of the most interesting events, we

come to the Colloquy of Poissy, at which Beza was the chief Protestant spokesman. The chief question at this gathering was, the nature of the Sacrament of the Lord's Supper. Beza said, in a previous conference held in the apartments of the Queen of Navarre, "We hold the bread to be the sacramental body, and we define *sacramentaliter* by maintaining that, though the body be now in heaven and nowhere else, and the signs on earth with us, yet it is as truly given and received by us, through faith in eternal life, as the sign is given naturally by the hands." This explanation caused the Cardinal of Lorraine to turn to the Queen, and exclaim, "Such is my belief, madam; I am satisfied." Charles presided at the Colloquy itself, and read a speech, hoping that it would lead to his subjects living together in peace and unity. The Chancellor L'Hopital followed by a liberal speech, which offended the bigots. Beza's sacramental theory scandalized many of the priests, who called him a "blasphemer," and at one of the private conferences which followed, the bishops rejected the Huguenot doctrine as heretical, and called upon Catherine to compel their submission, or to exterminate them. "For France," they said, "is a country that has never put up with heresy."

The Huguenot pastors unfortunately contributed their full share to the mischief which was brewing. They demanded the exclusion of women from the government of the state, and thus enraged Catherine as John Knox offended Elizabeth, by declaring female rule to be a "monstrous regiment;" and they likewise called for severe measures against "infidels, libertines, and atheists."

About this time there were more than two thousand reformed churches in France, and L'Hopital intimated that "a fourth part of the kingdom was separated from the communion of the Church." The Protestant portion, he said, consisted of "gentlemen, of the principal citizens, and of such members of the poorer sort as have seen the world, and are accustomed to bear arms. They have with them more than three-fourths of the men of letters, and a great proportion of the large and good houses both of the nobility and Third Estate." In fact, though some companions might be found for the Chancellor L'Hopital on the Papal side, the best and most advanced men of France were, as a rule, arranged in the Huguenot ranks, and whatever faults their leaders possessed, they exhibited the Puritan virtues of honesty, sobriety, veracity, and self-sacrifice. They were a noble protest against the vices of the time, and their slaughter and defeat inflicted an irreparable injury upon France. Under a more settled government they would have formed

an influential party growing in strength and gradually moulding the country, but Catherine soon found that a tolerant policy had perils she was not prepared to face. Philip II. was at his pertinacious crafty work in the Escurial, inflicting enormous temporary injury upon the Protestant cause, and unwittingly and insensibly preparing for the ultimate downfall of Spain. Stimulated and helped by Philip, the Popish party in France excited the populace to the most frantic and sanguinary disorder, in which a number of Huguenots were most barbarously destroyed. The Lieutenant-General of Burgundy, a partizan of the Guises, called upon the people "to overpower all who prayed elsewhere than in the churches, and to refuse drink, food, and shelter to the expelled rebels." With such teaching from the pulpit and from political leaders, murders in abundance now followed, and the Protestants were driven to organize for defence. Unluckily they were too late in their arrangements, and their opponents took possession of the king and his mother. A religious civil war was thus commenced; and from all quarters the Protestants rallied round Condé as their chief. The Huguenot army was superior in discipline and in the quality of its components, but their leader was not equal to the emergency, and time was lost in vain negotiation. Fresh atrocities were committed on the Papal side, and in spite of further efforts at negotiation, action began. The royal or Papal forces retook Blois, Tours, Poictiers, Angers, and Bourgs, everywhere committing the most horrible outrages and crimes. Then followed the capture of Rouen, where the Huguenots had unfortunately sacked the cathedral and defaced thirty-six churches, and the Papists glutted themselves with revenge.

Soon after this, Condé lost the battle of Dreux by his impulsive rashness, and the Duke of Guise returned to Paris as the victor and the most popular man of his party. Then came the assassination of Guise by Poltrot, and soon afterwards the so-called "Pacification of Amboise."

This war produced severe distress throughout the country, and the state of political confusion which followed it was worse than what had gone before.

The so-called "Pacification of Amboise" failed to restore peace, because the royal power was insufficient to enforce order, whenever either party thought proper to break it. On the Popish side the most horrible cruelties were perpetrated, and, though in far less number, similar deplorable deeds disgraced the Protestant cause. It is necessary for the truth of history that the hideous tale of

massacre, murder, and mutilation in their most disgusting forms, should be duly told, but it is foreign to our purpose in this review of the times to depict the atrocities of such fiends as Montluc and Des Adrets, or to show precisely how and when the Huguenots too faithfully copied the conduct of their persecutors. On the Papal side the best men had the least influence over the course of events while those who did lead, if not so bad as it has been common to suppose, were still very bad, and immensely inferior in moral character to the chiefs of the Protestant cause. To appreciate the conduct of Catherine and her son, Charles IX., we must bear in mind that after the Amboise failure to restore peace, the country was in the most wretched state of disorder, anarchy, and starvation. It would have puzzled much wiser and much honester heads than theirs to have surmounted the difficulties of the situation, and to have compelled the various parties to obey the law. Philip II., the Pope, and the bulk of the French priests exerted themselves like demons to promote bloodshed and persecution. No statesman of paramount influence on the king's side—which by unlucky accident rather than by design, was the Papal one—seems to have cared a rush for the good of France, or for anything but his own selfish ambition, and though Coligny and his associates were animated with far higher principles of patriotism as well as of morality, the circumstances were not favourable to their success.

In June 1565, when, after making a progress through the south and west of France, Catherine and Charles reached Bayonne, both had become personally acquainted with the fierce hatred with which the populace in many towns regarded the Protestants, and they were constantly called upon to extirpate the heretics. At Bayonne, Catherine and Charles met Isabella of Spain, attended by a magnificent retinue, and in addition to sumptuous pageants and festivities, conferences took place, in which the Spaniards urged an unrelenting crusade against the Huguenots. Isabella, acting by the direction of her husband, Philip II., urged her mother, Catherine, to dismiss L'Hopital, on the ground that he sheltered her bad subjects, and was a terror to the good, and the Duke of Alva replied to Catherine's defence of her Chancellor, that his master desired positively to ascertain whether or not she would put down heresy. At the last conference, the king, the two queens, Anjou, Alva, Don Juan Manrique, Don Francisca Alava, Montpensier, the Cardinals of Bourbon, Guise, and Lorraine, and the Constable Montmorency were present, when the Spaniards advised against civil war as too dangerous, but suggested seizing the Huguenot leaders and cutting off their heads.

The Duke of Alva observed that "ten thousand frogs," by which he meant Huguenots, "were not worth one salmon." Catherine did not fall into this Spanish plot. She wanted to use both parties for her own benefit, and again tried to avoid being made a mere tool of Philip and the Popish leaders. Her son, counselled by his mother, did the same. Efforts were made to induce the Guises to consent to reconciliation with Coligny, whom they accused of complicity with the assassination of the late Duke. The widow and the Cardinal of Lorraine expressed themselves satisfied with Coligny's explanations and disavowals, but the young Duke Henry of Guise wanted to be shut up in a room to fight the Admiral, and admitted that he had plotted his assassination.

Papal massacres, with Huguenot retaliation, continued to disturb the country, and about this time Philip sent 10,000 troops through Burgundy, under Alva, to destroy the Protestants in the Netherlands. Catherine, with real or pretended jealousy of this force, raised a royal army to watch it, and gave the Huguenots cause for believing that it would be used against them. To imprison Condé for life, and put Coligny to death, was said to be part of the scheme. The Protestants took to arms, and, as usual, did not manage their business discreetly. The Constable Montmorency commanded the royalists, who were by far the most numerous, and Condé commanded the weak Protestant force. The Huguenots fought splendidly, but the numbers of their opponents left them no chance of success, and their chief apparent gain in the conflict was in reality a misfortune—the death of the Constable, who was eighty years of age, and represented the more moderate views of his party. The Duke of Anjou, who succeeded Montmorency in command, was too young for a general, even if he had possessed the talent, and the Huguenot side began to succeed. Catherine then opened negotiations, and the extreme distress prevalent in France had begot such a desire for peace, that the Protestant army prematurely melted away. L'Hopital, as usual, honourably expressed himself in favour of toleration, and the Treaty of Lonjumeau was concluded, as another attempt at pacification. Probably again, at this period, if she had possessed sufficient power to keep the bigots in order, Catherine would have sided heartily with Coligny and Condé, not from any high motive, but because she was anxious to keep France independent of Spain from personal ambition, while they wished to do so from patriotic feeling. The Cardinal of Lorraine still exhorted to the extermination of the heretics, and fanatical Papists accused Catherine and Charles of deserving that name. In spite of the

treaty of peace, persecution went on pretty much as before, and the local authorities made regulations intended to vex or injure the Protestant converts. To make matters worse, the Court wanted money, and Catherine obtained a Papal bull, authorizing the alienation of Church property to the extent of a million and a half of francs, on condition of its being spent in extirpating heresy. She cheated the Pope in the appropriation of the funds, and her son made up for it by edicts of persecution, to which he was instigated by Lorraine. The war began again, and Condé was surprised at Jarnac, and had his leg broken by a kick from a horse, in spite of which he heroically endeavoured to cut his way through the enemy; but his horse fell, and he became a prisoner, to be immediately murdered by a follower of the Duke of Anjou.

Henry IV., then Prince of Béarn, and only fifteen (about the age of the Duke of Anjou), was brought by his mother to the Huguenot camp, and hailed as Commander-in-Chief, to replace Condé, though Coligny was the real leader. Coligny won a battle at Roche Abeille, made a mistake in besieging Poitiers, without adequate means, and suffered a severe defeat at Moncontour, in which his jaw was fractured by a pistol shot. After this came more fighting, and then a fresh treaty named after St. Germain's, where it was signed, and which made considerable concessions to the Huguenots.

Historians have questioned the character of this transaction, whether it was intended to maintain peace or only a snare to induce the Protestants to disarm, that they might be caught at a disadvantage. Dr. White decided in favour of the former view, which has the advantage of being in conformity with the general character of Catherine's policy of using the Huguenots as a balance to those opponents of whom she was more afraid.

The character of Charles at this period is enigmatical and contradictory. Probably he had lost all self-control, but not all good qualities, so that at times he behaved with humanity and discretion, and at others like a wild beast. Veracity was a scarce virtue in the courts of his time, and he seems to have had less than usual of what was too often considered an unregal quality. His marriage with Elizabeth, daughter of the German emperor, Maximilian, afforded some hopes of tranquility, as she was expected to exert a beneficial influence over him, but none of the Protestant leaders were present at the rejoicings. If the Papists had been quiet, the St. Germain's treaty might have maintained peace, but there was an incessant clamour for persecution; the queen mother was denounced as Jezebel and the king as Judas, for not gratifying the malignant

wish. The circumstances were favourable to Coligny's acquiring influence at the court, as Charles was evidently afraid of the Guises, who, seeing a prospect of losing their power, determined to get the Admiral out of their way. The Duke of Anjou joined Henry of Guise in hiring Maurevel to assassinate Coligny, but instead of killing him outright, the ruffian only inflicted wounds. This made the position of the Guise faction desperate, and Catherine became their accomplice in order to screen her favourite son. The King was frightened by tales of Huguenot conspiracy, and his mother, having made up her mind to a massacre of Coligny and other Protestant leaders, induced him to give his consent. Thus, the final catastrophe was brought about through Catherine's affection for her young monster of a son, Henry of Anjou, and had he been out of the way, or a little less imbued in guilt, St. Bartholomew's Day might never have acquired its evil renown. The nature of the various incidents do not look like the several portions of an elaborate plot. There were bad circumstances, awkward conditions, and thoroughly unscrupulous agents acting from hour to hour as their selfish interests prompted. The catastrophe in itself was spasmodic rather than premeditated, and far exceeded the intentions of those who brought it about.

Dr. White has produced the best book on this subject. He has left many interesting questions of personal character and motive to be discussed, or cleared up; but he has the great merit of having first distinctly represented the massacre as a portion of a long, and in the main, intelligible chain of events. Viewed in this way it is more instructive and more interesting to the philosophical student than if regarded as a mere outburst of personal guilt.

STORMS AND HURRICANES: THEIR MOTIONS AND CAUSES.

(*Concluded.*)

BY HENRY WHITE, PH.D.

In our last number we described some of the more striking characteristics of hurricanes, and endeavoured to explain certain of their phenomena; for the science of meteorology is still so fragmentary and incomplete, that much still remains for which we cannot account, according to the known laws of physics. One thing, however, seems pretty generally agreed, that hurricanes are cyclones, or revolving winds, moving like the smoke-rings from the bowl of a tobacco-pipe or the muzzle of a cannon. In the latter instance these rings have been observed to have sufficient velocity to disturb the foliage of distant trees. The reality of the gyrating movement of hurricanes is traceable at sea by the aid of numerous and widespread observations, which are not easily deciphered by untechnical readers; but there are phenomena noticeable on shore that none can fail to understand. Thus at Barbadoes in 1831 the trees in the northern part of the island lay from N.N.W. to S.S.E., having been prostrated by a northerly wind in the earlier part of the storm; while in the interior and other parts of the island, they lay from south to north, having fallen in the latter portion of the gale. More numerous and striking examples of this rotatory action are found in the tornadoes, which may be called "concentrated hurricanes," or circular storms with a very small radius. In the Brandon Tornado (January 20, 1854), so carefully described by Professor Stoddard, in Silliman's "American Journal," vol. xviii., a fence was thrown down, the western half of which was turned towards the south, and the eastern half towards the north. "If the rails had been removed by hand and laid on opposite sides, the result could not have been more regular." In a forest the trees were prostrated in all directions, but not irregularly. Those to the right of the centre-path of the storm fell in a line exactly parallel with the direction of the path; thence they were prostrated in gradually widening angles, until they lay nearly at right angles with the path, and so on. Trees lay in piles upon each other in quite opposite directions. Some portions of a building destroyed by the storm were carried to the north, some to the south-east, and

others to the west of the foundations. In the Providence Tornado (August 1838), two fences, lying almost parallel with the course of the storm, were thrown down, one northwards and the other southwards. In the Mayfield Tornado (*vide* Silliman's "American Journal," vol. xliii.), the chimney of a house was carried east, and the ridge north-west. Among the piles of trees thrown down in a wood, the bottom tree invariably pointed westward, and the top tree eastward.

It is a pretty well ascertained fact that in tornadoes the air moves spirally upwards, forming an inverted cone with the point downwards. Like a huge funnel, gyrating on its end, a tornado sweeps over the country, sucking up (as it were) the loose objects it encounters, and dropping them far from the places whence they were taken. The same incidents are observed in hurricanes. During a lull in the great Barbadoes hurricane, "the falling of tiles and building materials, which by the last gust had probably been carried to a lofty height, were clearly audible." In the Brandon tornado, a bier was lifted from the graveyard, borne across a road, and deposited in a field. A horse was taken up into the air and carried over a fence; and a cow was blown nearly seventy yards, striking against a tree twelve feet from the ground. In the Mayfield tornado, a boy about eleven years old, while attempting to shut a door, was whirled through a window just burst open, carried a distance of about eighty feet, and dropped down with no more injury than a scratch in the face. At Guadaloupe, during a hurricane (January 26, 1825), a brig was whirled out of the water, and actually blown to pieces in the air (*naufragé dans les airs*). At Santa Lucia in 1780, men and animals were raised from the ground and hurled to a distance of many yards. These things seem incredible, but they are too well authenticated to be doubted. It may be owing to this upward spiral movement that both tornadoes and hurricanes not unfrequently skip over wide tracts, coming down upon the earth, as if by successive leaps, at long distant intervals. But into this matter we cannot enter further than to say that we once witnessed a curious instance of this at Sallèsles, near Narbonne, where a black cloud rushed down from an adjacent mountain (le Pech de Ricaud), and dashing through the village with terribly destructive effect, went bounding and jumping through the plain, leaping over walls and olive plantations, like some atmospheric giant let loose from the cave of Æolus.

The cyclones or hurricanes, as they move forward, do not follow a straight line, but, like huge aerial tops gyrating upon the surface of

the earth, adopt a parabolic course. Their birthplace seems to be not far from the west coast of Africa, on the northern margin of the belt of equatoreal calms. Thence they move in a more or less N.W. path until they approach the coast of North America in 30° N. lat., where they begin to turn, and continue to the N.E., the vortex gradually widening, until they are lost in the wide ocean between Iceland and the British Isles. Some meteorologists suppose their origin to be mechanical. The superior westward velocity of the air (argues Professor Rogers of Glasgow) within the Trade Winds, compared with its sluggish progress on the border of the equatoreal calms, engenders a rotation of the air with a westerly progression of the axis of revolution; precisely as a swift current of water produces small whirlpools wherever it comes in contact with still water, or with a current moving more slowly in the same direction. In the North the gyrating tendency must necessarily be E.N.W.S., or against the sun. In the southern hemisphere (which we have purposely left out of consideration) the direction would be contrariwise. The curious experiments of Count Xavier de Maistre for illustrating the cause of waterspouts, published in the "Bibliothèque Universelle" of Geneva for November, 1832, throw considerable light on the generation of these rotatory motions, and to some extent explain why the movement becomes more rapid than the cause producing it. But if these experiments seem to lead necessarily to the conclusion that the immediate cause of waterspouts, whirlpools, tornadoes, and cyclones is purely mechanical, what is the remote cause, what gives the first impulse? It may be the electric condition of a portion of the atmosphere, or the sudden heating of the air over some insulated spot on the African mainland. The movement once excited, the direction taken by the revolving mass is easily explained. The N.E. trade wind pushes it forward in a westerly direction; the form of the South American continent turns it slightly to the right of the due western path; the West Indian Islands and other parts give it a still greater northern tendency, until it reaches the latitude of Florida, when the upper current from the equator seizes hold of it, and carries it away to the Atlantic, east of Newfoundland. As regards the cause of these terrible atmospheric movements, as well as of those gentler fitful currents we call winds, there is strong ground for believing that they are not occasioned by heat alone. And though it is well known that an immense conflagration, like the burning of a forest, may produce a whirlwind; hurricanes do not occur in seasons when the heat is greatest, or in places where the sun's rays are fiercest. Out of 326 hurricanes recorded by M.

Poey, 35 occurred in July, 88 in August, 77 in September, and 66 in October.

Some very curious instances are recorded of what is called circuit sailing in these vortical storms. Thus one ship, the "Cabot," scudding before the wind, performed nearly half the circuit of the horizon before the gale abated. But the most striking examples occur in the southern hemisphere, where the progressive movement of the hurricanes or typhoons is often very slow:—the "Robin Gray" ran one and a half times round the axis of the storm, until disabled. In like manner the "Argo" made part of the second circuit. The "Charles Heddle" made five complete revolutions in 117 hours, with an average run of 11·7 knots an hour, the whole distance sailed being 1373 miles, while the progression of the hurricane was less than four miles an hour. During this time the ship made a good course of only 354 miles.

In conclusion, it may be well to add a few words as to the rate at which hurricanes or cyclones travel, the width of the surface embraced by them, and the length of their paths. The hurricane of last October took about an hour to travel from Tortola to St. Thomas, a distance of ten miles. Some have advanced at the rate of thirty miles an hour, others at only twelve, while in some of the rotatory storms of the Asiatic and Indian seas the progression has been as slow as three, and even two miles and a half per hour. The "Royal Charter" cyclone moved at an average rate of fourteen miles an hour. It reached Liverpool twelve hours after the wreck of the ship, after which it is named. Here its greatest horizontal motion was fifty-seven miles an hour. Cyclones may cover an immense surface—from 100 to 500 miles in diameter, or even more; if we suppose that the observations recorded in the latter cases refer to the same and not to different storms blowing at the same time. So far as we are at present informed, the Tortola hurricane was probably not more than fifty miles in diameter, while in the case of the "Royal Charter" it was between 300 and 400 miles. It will be understood that the wind acts with diminished violence towards the exterior, and with increased energy towards the interior of the vortex in obedience to the law of equal areas in equal times. The length of the path can only be vaguely estimated, because we do not know in any single instance precisely where it began and where it ended. We only know that it was first observed in one spot, and observed last in another. The hurricane of August, 1830, has been traced from near the Caribbee Islands, and thence to the coast of Florida and along the Carolinas, until it reached the Banks

of Newfoundland, a distance of more than 3,000 miles, which it traversed in six days, at the average rate of about eighteen miles an hour. The hurricane of August, 1827, travelled over 3,000 nautical miles in about eleven days, at the average speed of eleven miles an hour. The September hurricane of 1830 travelled about 1,800 miles, at an average rate of twenty-five miles an hour, and that of September, 1831, passed over the same distance with a velocity of thirty miles an hour. The Cuba hurricane of October, 1844, moved through 12° of latitude with a speed of forty-three miles an hour, its diameter exceeding 1000 miles, so that the storm-path in its total course spread over 2,400,000 square miles. The advance of the gale from lat. 27° to lat. 42° was about 1032 miles in a day. There is some difficulty in estimating the diameter of a hurricane; but in the last instance Mr. Redfield concludes, from data which he has carefully tabulated, that the violent hurricane path of the storm was within a diameter of 500 miles, and as a storm or reefed-topsail gale, 1084 miles. Attempts have been made to calculate the extent of the axial region or area of inactivity in the centre of the hurricane, but the results have come out so variable that no reliance can be placed on them. We only know for certain that this calm region widens as the hurricane advances into higher latitudes.

The vertical height of the hurricane is not conterminous with the height of the atmosphere. During the progress of a cyclone two strata of clouds are observable; the upper moves with the general or local current overlying the storm, and below it is the storm scud flowing nearly in the same direction as the hurricane, but not quite, the scud running, for instance, S.S.W., while the cloud-direction is S.W. In the United States, says Mr. Redfield, the general height of the upper stratus cloud is about one mile, and often below. It must not, however, be concluded that the stratum of revolving wind is of equal height and thickness throughout its extent. Probably it would be found highest near the centre, and sloping gradually away until it coincided with the ordinary current. There are indeed indications to show that violent winds of great horizontal extent are vertically limited to a thin sheet or stratum, like an atmospheric quoit whirling through the air.

It is generally supposed that Franklin was the discoverer of the gyratory theory of hurricanes, but it is not so. It was first suggested by Mr. Richard Budgen in a pamphlet of twenty-eight pages, entitled, "The Passage of the Hurricane from the Sea-side at Bexhill in Sussex, to Newingden Level, 20th May, 1729. London, 1730." Prefixed is a chart describing the course of the storm

from W. to E., with its curves against the sun, increasing or diminishing in diameter, in apparent accordance with the nature of the country over which it passed. That peculiar brightness, the eye of the hurricane as it is called, was plainly observed; "such a strong light in the clouds as far exceeded any of the preceding flashes of lightning." That Mr. Budgen had anticipated later meteorologists is clear from the terms he uses. "The direct velocity of the storm," he says, "is forty-two feet in a second, to which adding forty-two feet for the increase by the vortiginous or spiral motion, makes eighty-five feet, which is the space run through in every second of time near the outward verge of the gyration." He was aware of the calm spot in the centre, though failing to account for it, but adds, "the reason of the trees falling in all kind of directions will readily be understood by a view of the spiral line in the plan." Budgen's theory does not appear to have borne immediate fruit; but it was probably known to Franklin, for his pamphlet was dedicated to Sir Hans Sloane, then president of the Royal Society. Of the author we know only that he was a careful observer, that he lived at Frant, near Tunbridge Wells, and had invented "a new engine to work by the wind."

ASTRONOMICAL NOTES FOR MARCH.

BY W. T. LYNN, B.A., F.R.A.S.
Of the Royal Observatory, Greenwich.

In our notes for this month we shall commence with the positions of the planets.

Mercury will not be well placed for evening observation. Early in the month he sets about half-past six, but being earlier each night, he will soon become invisible to the naked eye through the increasing twilight. At the end of the month he will be approaching his greatest elongation, and will be tolerably conspicuous before sunrise, rising in the last days shortly after five o'clock. He will be in inferior conjunction with the sun at ten o'clock on the morning of the 8th, and will be horned throughout the month.

Venus will be gibbous in form during the whole month. She will be readily observable in the evenings, setting on the first day at eight minutes past nine, and on the last day not until twenty minutes to eleven. On the 27th, a little before two in the afternoon, she will be in conjunction with the Moon, being at the time about $6\frac{1}{2}°$ to the north of that body.

JUPITER will be in conjunction with the Sun on the 10th, and will, of course, not be observable throughout the month.

SATURN will be in view very late in the evenings. Having, however, a considerable southern declination, he will be always low in the heavens. At the beginning of the month his rising will not take place until about a quarter past one in the morning; at the end of it exactly two hours earlier. In our notes for next month we shall offer some remarks upon the position of the rings, and the present state of our knowledge concerning them. On March 13th and 14th the planet will be very near the Moon, being in conjunction with her at eleven o'clock on the morning of the latter day. Saturn's position during this month amongst the stars will be in the constellation Ophiuchus, about halfway between χ and ψ Ophiuchi, two stars of the 5th magnitude.

OCCULTATIONS.—We give our usual table of these phenomena, remarking that the Moon's passage through Taurus on the night of the 1st will occasion some of especial interest, particularly those of θ^1 and θ^2 Tauri, two equally bright stars of the 4-5 magnitude, distant from each other by only about six minutes of arc. σ^1 and σ^2 Tauri are also very close, but the former will escape occultation. The disappearance of 71 Tauri will take place in daylight, but may be observed with a good telescope. Towards midnight the Moon will, in her journey through Taurus, pass a little to the south of Aldebaran.

OCCULTATIONS OF STARS BY THE MOON.

DAY.	NAME OF STAR.	M.	DISAPPEARANCE.		REAPPEARANCE.	
			MEAN TIME.	V.	MEAN TIME.	V.
			h. m.	°	h. m.	°
March 1	71 Tauri	6	5 21	59	6 20	332
„ 1	θ^1 Tauri	4½	6 39	129	7 52	296
„ 1	θ^2 Tauri	4½	6 39	109	7 53	316
„ 1	85 Tauri	6	8 32	93	9 26	353
„ 1	σ^2 Tauri	5½	12 14	63	12 33	23
„ 2	111 Tauri	6	5 25	52	6 30	307
„ 28	48 Tauri	6	7 8	120	8 11	332
„ 28	γ Tauri	4	9 5	147	10 1	304

The angle V. is, as usual, the angular distance on the Moon's disc, counting from the highest apparent point to the right hand, in an inverting telescope, at which the disappearance or reappearance takes place.

The Moon is in her first quarter at 4h. 49m. on the morning of the 2nd. On the evening of the 1st, therefore, the terminator will pass over the curious formation Hipparchus, nearly in the centre of the Moon. This is a region well deserving of careful examination. Mr. Birt has recently called attention to some remarkable changes of appearance in a small crater on the south-west side of the ridge forming its north-eastern boundary, which he compares to those which would seem to have occurred in Linné. On the evening of the 2nd the well-known walled plain Archimedes, and the grand chain of craters running southerly from the centre of the Moon, near which is the largest, known as Ptolemy, will be regions observable with advantage. Copernicus will be best studied late on the 3rd, and early on the evening of the 4th, when the terminator will intersect, between that object and the Moon's north point, the large plain called the Mare Imbrium. On the 6th the deep crater Kepler, connected with Copernicus by rays, may be well observed. Aristarchus will be on the terminator late that night.

On the 8th at 8h. 22m. the Moon will be full. The night of the 10th the retreating terminator will pass over part of the Mare Crisium, and on the 11th also over the Mare Fœcunditatis. As it is the opposite quarter of the year to that which furnishes the Harvest Moon, our satellite will rapidly cease to be visible in the evening. The conjunction will take place at six o'clock on the morning of the 24th, so that on the evening of the 27th the western edge may again be studied. The interesting Mare Crisium will be traversed by the terminator on that day and the 28th. On the 29th the Mare Tranquillitatis will be in view, and to the south of it will appear the shadow of the ring of the very remarkable and deep crater Theophilus. On the 30th the now famous Mare Serenitatis will be under the terminator, and on that night and the 31st, Hipparchus may again be studied. The Moon will be in the first quarter soon after noon on the 31st (0h. 26m.).

As a reminder to those engaged in star-observing, we will just mention that six o'clock in the evening corresponds, on March 1st, to 4h. 40m. sidereal time, and, on March 31st, to 6h. 39m.

The Sun.—The announcement made at the meeting of the Royal Astronomical Society last January, respecting the regularity with which observations of solar spots are now carried on simul-

taneously at Kew and at Dessau, leads us to devote a little space to this interesting subject. Two points have lately given rise to controversies in connection with it—the nature of the periodicity of the spots, and the physical character of the spots themselves.

With regard to the former, it is well known that the veteran observer, Schwabe, of Dessau, after thirty years of patient labour in daily registering every spot visible in his telescope, was allowed, in 1857, to have completely established the fact, previously unsuspected, that a period existed in the frequency of spots, which was completed in about ten years. Thus in the years 1828, 1838, and 1848, there were no days on which the Sun's disc was destitute of spots, whereas in the years midway between these, there were a very considerable number of such days, or a minimum number of spots was seen. About the time of Schwabe's discovery, it was remarked by Professor Lamont, of Munich, that the mean diurnal variation of the magnetic declination was also subject to a period in its amount which was likewise completed in about ten years. By the discussion of a large number of observations, he arrived at the conclusion that the actual length was 10·43 years: and he thought it probable that that was also the more exact length of the solar-spot period. Professor Wolf, of Zurich, contended on the other hand that the period of both phenomena was rather longer than this, being about 11·11 years, and Schwabe himself assented to this as probably the more exact number. General Sabine noticed also a decennial period in the frequency and amount of the magnetic disturbances or storms; but this seems to be not so clearly established. The matter is one well deserving of continued attention; and it is one in which, so far as the solar spots are concerned, possessors of even small telescopes may do good service. We believe that the following extract from a letter from Professor Challis of Cambridge, to the writer of these "Notes," will present our readers with the most reliable view of how it at present stands. "I have for a considerable time* regarded the $11\frac{1}{9}$ year period of magnetic declination and variation, as established by the researches of Hansteen, who has very carefully considered this question. I think that with hardly less certainty Wolf has made out the same period for the solar spots . . . The correspondence between the *inequalities* of the intervals between the maxima and minima, which, according to Wolf, is detected on comparing the variation epochs with the solar spot epochs, is a critical point, which, if well made out, almost necessarily indicates a relation

* The letter is dated 1866, April 9.

between the two classes of phenomena. As to the epochs of maxima and minima of magnetic storms, it may very likely require a long course of observations to determine how far they are periodic, and whether the period is the same as for the other magnetic phenomena. From what I noticed when at the Cambridge Observatory, I am disposed to conclude that periodicity of a like kind will be eventually made out."

The other point to which we alluded was the cavernous, or otherwise, nature of the solar spots. Wilson's phenomenon, as it is called, from being described in 1773, as observed in some cases by Professor Wilson, of Glasgow, was, until lately, considered to be decisive for the spots being situated at a lower level than the rest of the surface of the Sun. It consisted in the varying form of the umbra and penumbra of the spots as they proceeded by the Sun's rotation, from one side to the other of his disc. Hence the theory that the body of the Sun's disc is separated from the luminous atmosphere or photosphere by a transparent elastic medium, supporting within it a cloudy stratum, which, reflecting some light from above, forms the penumbra of a spot, whilst the umbra is caused by an opening in this, laying bare the solid body itself, which reflects no light at all.

Now, Kirchhoff, the discoverer of the cause of the dark lines in the solar spectrum, opposes, on chemical principles, this theory. He suggests that the umbra and penumbra of a spot are in fact due to two strata of cloud suspended in the solar atmosphere. He says, indeed,* "I have developed this theory, not from believing that I have established its accuracy, or even being myself convinced of its truth, but merely to show that the phenomena of solar spots are in some measure intelligible without the supposition of a dark and cold body of the Sun, which was, so far as I know, the received opinion amongst astronomers, in spite of its being in contradiction to most clearly-proved physical truths." According to Kirchhoff's theory, the body of the Sun itself is in a state of intense ignition, so that by photosphere he understands the surface of the Sun's body, which he supposes to be surrounded by a cooler atmosphere, in which local diminutions of temperature, give rise, as in our own, to the formation of clouds. And this, he says, appears to be supported by the observations of Father Secchi, whence it appears to result that the polar regions of the sun possess a lower tempera-

* "Astronomische Nachrichten," No. 1634. He here, in a letter to Dr. Spörer, of Anclam (whose labours on solar spots are deserving of all praise) answers some objections which had been brought forward against his theory by M. Faye.

ture than the equatorial zone, occasioning, as on the earth, but with more regularity, an atmospheric current from the poles towards the equator, and a return current at a higher elevation. Thus a region where the two currents mutually bound and destroy each other may be the only one in which clouds are generated of sufficient size and density to appear to us as spots.

If Kirchhoff's theory be correct, the spots are not a *lower*, but at a *higher* elevation than the other visible parts of the Sun's disc or photosphere. It becomes, therefore, exceedingly interesting to know how far Wilson's phenomenon is or is not usually seen during the motion of a solar spot across the disc. Mr. Balfour Stewart and Mr. De La Rue have been carefully examining this question at Kew. It is one which those in possession of moderately good telescopes may help satisfactorily to decide.

MICROSCOPICAL VARIETIES.

A FEW subjects of interest to microscopists may be conveniently grouped together under the above heading, though they have nothing in common but their relation to one favourite instrument of research.

We shall commence by adverting to an alleged discovery of a special vegetable colouring matter called *Xylindeine*, by M. Rommier, who describes it in "Comptes Rendus." It appears that in the Forest of Fontainebleau, and less often in other French forests, dead wood is found which possesses a decided bluish-green tint. The green matter is stated by M. Fordos to be soluble in sulphuric and nitric acids, and to be precipitated without alteration by water. M. Rommier procured a quantity of the green wood, and instead of finding M. Fordos's green matter, called by that gentleman *Xylochlocric acid*, he discovers another substance which dissolves easily in water, giving it a fine bluish-green colour. Acetic acid changes it blue, and most of the other acids precipitate it as green. He says, the "most interesting fact is that, like indigo, it dissolves in alcohol (85° strength) in presence of potash and glucose, and the solution, which is at first brown, becomes green on contact with the air, and soon deposits the colouring matter in a gelatinous form. Silk and wool are easily dyed with it by adding acetic acid to an aqueous or ammoniacal solution of the colouring matter, steeping the thread in it and heating the solution to 80° (C)."

To prepare this *Xylindeine* the wood is dried, powdered, and washed with an alkaline solution containing one per cent. of soda or potash. The liquor is filtered and treated with hydrochloric acid, which gives a voluminous precipitate. The precipitate is composed as follows :—

Carbon	50·23
Hydrogen	5·33
Nitrogen	2·63
Oxygen	40·81
Iron and lime	traces

M. Rommier, who does not seem to know that this sort of green wood is well known to fungologists, finds, on microscopical examination, coloured fibres disposed in various directions, and chaplets of green ovoid sporules. He says it is most commonly found in oaks, and occasionally in birch, the yoke elm, and beech.

The "green oak" of the Tonbridge Wells fancy articles, is a wood affected in this way, and we have in our possession a specimen of birch in the same state. In his "Outlines of British Fungology," p. 67, Mr. Berkeley observes that "when wood is impregnated with the spawn of *Peziza æruginosa* it assumes a beautiful green tint. This is applied to various ornamental uses by the turners of Tunbridge Wells. Few people who admire it when manufactured, are probably aware to what it owes its attraction." Wood in this state made into sections is a very beautiful object for the microscope. It should be viewed in thin sections one transverse and two vertical, one *radial* and the other *tangential*. This last shows the way in which the medullary rays are disposed to great advantage.

To pass to another subject, as the season is coming on, we should recommend a search for specimens of that exquisite larva, *Corethra plumicornis*. It is easily recognized by its glassy transparency, and large conspicuous air-sacs. Professor Rymer Jones, some months back, read an interesting paper on the subject, which will be found in the "Quarterly Journal of Microscopical Science." It remains for him, or some other observer, to trace the real history of the development of the tracheal system, which he states to become suddenly visible.

Some time ago, Professor J. C. Schiödte investigated the mouth-organs of the louse (of which we gave an account in the INTELLECTUAL OBSERVER), and demonstrated that it was a suctorial apparatus, and not at all calculated to bite in the manner supposed by writers on the *mortus pediculosus*. The same naturalist has been at

work on the structure of the mouths of the "sucking crustacea," and a translation of his paper will be found in "Annals Nat. Hist." for Jan. 7. We allude to it now merely because it suggests an interesting branch of microscopic study, especially of the mouth-organs of the small parasite crustaceans, many of which are easily obtained.

In investigating small live objects, great advantage will be found in employing the *slide-cells* devised by Mr. Curteis, of Baker's. They can be had of all sizes, to suit elongated larvæ, small worms, or the rounder objects, such as conochilus or cypris. A thin covering-glass rotates over an excavated cell. It should be partially withdrawn from the cell, when the object and water can be readily introduced through a dipping tube. The cover and the slide under it should be kept free from grease, or the water will slip away, instead of remaining in the cell. This is easily done by a little caustic soda. We may mention that the same precaution is necessary in working with Professor Smith's excellent "growing slide," and for want of it some experimenters have been disappointed.

Perhaps the most awkward piece of apparatus attached to a microscope is the common *stage forceps*. Approximating their limbs in an angular fashion, they do not readily hold elastic objects. and cannot be adjusted to any great variety of size. At the request of Mr. Slack, Mr. Ross has constructed an elegant screw object-holder, with sides that approach each other in a parallel direction, like the biting portions of a screw-hammer. The screw being fine, very delicate objects, like crystals of salts, can be firmly held, without risk of injuring their edges. It is found most desirable to mount this object-holder on a small brass frame, which lies on the stage. It has universal motions, and is well adapted to the lieberkuhn, or other illuminating apparatus. It will hold objects from nearly an inch wide, down to fine hairs, and will prove a great convenience to observers.

Microscopy is evidently on the increase, all the principal makers being very busy, and the attendance at the meetings of various societies good. The anniversary meeting of the Royal Microscopical Society, on February 13, disclosed a very flourishing state of its affairs, and the Old Change Microscopical Society gave a splendid entertainment to about thirteen hundred visitors on the 17th at the Cannon Street Railway Hotel. It is impossible not to view with great sympathy the honourable efforts which many of our great firms now make to promote educational movements, or intellectual recreation. A few years ago some commercial blockheads remon-

strated with the late Sir John Lubbock, on the danger his scientific pursuits might do to the credit of his important banking firm. No one now doubts that the present baronet is a good banker because he is known as a good entomologist, and firms like Leaf, Morley, and others, who cannot possibly be accused of indifference to business, are raising the character and social standing of their *employés* by directing their attention in leisure hours to microscopic pursuits.

THE DRAGON TREE OF TENERIFFE.

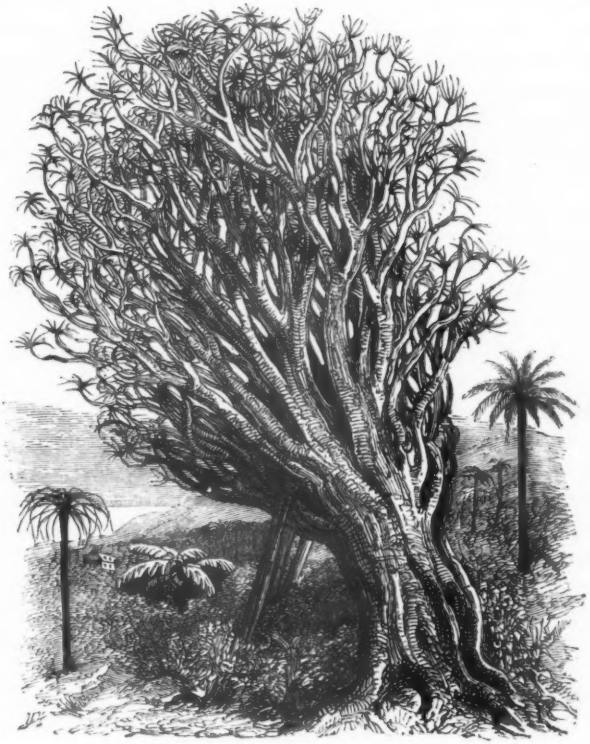
BY JOHN R. JACKSON,

Curator of the Museum, Kew.

One of the oldest and most interesting vestiges of vegetable life has recently been removed from the spot where it has stood for an almost indefinite number of years, making the place of its growth famous from the fact of its presence. We speak of the celebrated Dragon tree (*Dracæna Draco*) which until recently stood at Oratava, Teneriffe. The removal of this time-honoured tree is due to a furious gale which swept across the island last autumn, but of the effects of which botanists have only just become acquainted. This great loss to the botanical world is the more to be regretted, as it seems that little or no care had been taken by the Spaniards to prop, or otherwise support the tree, which, though living and healthy, from the very fact of its age must have required such aid, being computed by some authorities at six thousand years old.

In July, 1819, the tree was severely injured by a great storm, but it survived, and remained until recently one of the wonders of the vegetable kingdom. The *Dracæna Draco* belongs to the natural order *Liliaceæ*, and is, consequently, a near ally to the asparagus. We have it in cultivation in our hothouses in this country, but of course in a young state. At Kew the plant has attained a height of between twenty and thirty feet, entirely unbranched, the stem marked with the scars of fallen leaves. These tall, straight stems, with a tuft of long leaves at the top, have much the appearance of Yuccas, or rather small palms, and give no idea of the habit of the great tree now destroyed. This young state of the plant has been called the first age, or infancy, and in its native country

lasts for a period of twenty-five or thirty years. The second age is that of maturity, or reproduction, and the third age the age of decay. At the second age the leaf scars disappear, and the trunk increases in thickness by the formation of branches; towards the close of this period the plant puts forth its flowers. In the last, or



THE DRAGON TREE OF TENERIFFE.

third age, is produced the irregular, or gnarled appearance which the stems of old Dragon trees exhibit. This appearance is produced by the giving-off of aerial roots, and the formation of glandular excrescences on the hollow part of the interior of the trunk. The leaves, which are three feet or more long, and one to two inches wide, are straight and sword-shaped; the flowers are pale yellow or greenish white, and appear in panicles upon the leafy extremities of the branches. The fruit is a yellowish green berry, becoming

scarlet when ripe. The introduction of the plant into this country is said to date from about 1640. The great interest of the Oratava tree was its immense size and great age. Baron Humboldt says, when he visited Teneriffe, that the tree was included in the garden of M. Franchi. "In 1799, when we climbed the peak of Teneriffe, we found that the enormous vegetable was forty-five feet in circumference a little above the root. Sir George Staunton affirms that at ten feet high its diameter is twelve feet; its height was reckoned at from seventy to seventy-five feet."

Signor Fenzi, of Florence, who visited the tree in the early part of last year, says it was then in excellent health, "its immense crown covered with innumerable panicles of scarlet fruits, and the huge trunk, although completely decayed in the interior, sustained vigorously the spreading mass of fleshy branches and sword-like foliage. On the west side, where the ground was sloping, a solid wall had been built under about one-third of the trunk, while on the other side two or three half-rotten staves propped the more projecting branches. All around the trunk a dense bush of climbers and other plants clothed its expanded base in a very picturesque confusion. I remember now some bignonias, jasmines, heliotropes, abutilons, etc., and also a flourishing almond tree, covered with blossoms, that had grown quite close to the trunk. Its circumference (as far as I was able to measure it, on account of the inequality of the ground) was not inferior to twenty-six mètres (about seventy-eight English feet), while the total height of the tree did not exceed seventy-five feet. And it was remarkable, that through some crevices in the trunk a small Dracæna was to be seen, growing spontaneously in the decayed substance furnished by the parent tree."

If we accept the theories of some authorities, it seems scarcely right to speak of this famous tree in the singular, but rather as a conglomeration of trees, for it appears very possible that the old trunk provides nourishment for the roots of the so-called upper branches, which are thought to be more properly young individual trees; the roots of the upper stems seem to penetrate under the bark of the lower decaying ones, and after the upper stems have branched, their life also leaves them, and they are replaced by young trees of a similar formation on the summit of each of the branches. Thus the upper portion of the old Dragon tree of Orotava would, in fact, be a miniature forest of young plants, deriving their nourishment through the old trunk, and in the downward course of their aerial roots adding new tissues to the trunk, so as to support their

own weight above. It is recorded that the old hollow trunk at Teneriffe has served more than once for a temple for the performance of religious rites—firstly by the Guanches, and later, in 1493, by the Spanish conquerors.

The name of Dragon tree, or Dragon's-blood tree, appears to be derived from the resin which exudes from the trunk, and is known as dragon's-blood, though the dragon's-blood of commerce is chiefly obtained from *Calamus Draco*, an East Indian palm. The Guanches appear to have used the resin of the Dracæna for embalming their dead, for it has been found within their sepulchral caves.

In the Museum at Kew are preserved two relics of the old tree, namely—portions of the branches, one about ten feet high and one foot in diameter.

ACKLAND'S DIVIDING MACHINE.

Mr. Ackland (of Messrs. Horne and Thornthwaite's) is well known as one of the few opticians who dignify their occupation by original talent and scientific culture, and he has recently perfected a method and a machine for dividing instruments according to any scale which admits of calculation. The original purpose of Mr. Ackland's invention was to give a practical answer to a demand made by Mr. Glaisher for a mode of dividing alcohol thermometers, so that the inequality of the degrees should exactly correspond with the inequalities in the ratio of that fluid's expansion, when exposed to a gradually rising temperature. The problem may be better understood if we say that degrees of equal magnitude in a tube of uniform bore do not correspond with the spaces occupied by alcohol as it rises in temperature from a low point of the scale to a high one, or *vice versâ*. In a paper read before the Meteorological Society, Mr. Ackland remarks that "it is well known that the expansion of alcohol by heat is not proportionate to its change of temperature; and we are consequently unable to express its corresponding co-efficient by a simple formula, as for metals and mercury, but must adopt the more complex formula of M. Biot.

$$d = at + bt^2,$$

where a and b are the required co-efficients, and t the temperature."

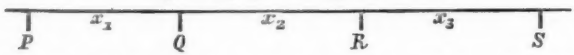
The co-efficient of dilatation for mercury is not the same for all temperatures, but the errors resulting from disregarding this fact amount to very little. Not so with alcohol, for if an alcohol ther-

mometer is marked off correctly at a few positions ten degrees apart, and the interspaces are graduated *equably*, the errors will be found sufficient to vitiate all nice observations. Now it is apparent that any dilatation conforming to a known law of increment, differing from a simple scale, can be represented by degrees, the magnitude of which varies as the law directs; and Mr. Ackland's object was to devise a machine which would reduce the ruling of lines of this description to an exact mechanical operation.

We shall borrow from his paper in the "Proceedings of the Meteorological Society," the following description of the principle involved in his plan:—

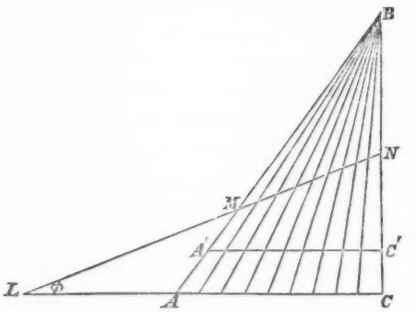
"To illustrate this new method I have invented, let us suppose we have ascertained the fixed points, P, Q, R, S, of a thermometer corresponding to equal differences of temperature. And let

$$P\,Q = x_1,\ Q\,R = x_2,\ R\,S = x_3$$



It is desired to divide the intervening spaces each into ten divisions, so that each division shall occupy its true position.

"To do this, take any right-angled triangle, A B C, and divide the side A C into ten equal parts by straight lines drawn from B.



"Then, if a straight line, as A′ C′, be drawn parallel to A C, it will be divided into ten equal parts; but if it be drawn not parallel to A C, it will be divided into ten unequal parts."

It is evident from inspection of the diagram, that in proportion as a moveable arm, L N, is raised above the base, A C, the spaces marked off upon the group of radiating lines will differ from each other in magnitude, and that by setting this arm to any particular angle a series of interspaces will be obtained, diminishing in any definite proportion that may be required.

Mr. Ackland's machine is so constructed, that by setting it in this way it will rule off upon glass or other material a scale with any regular degree of increment required. If for any particular purpose an irregular scale were wanted, it would prove equally efficient, provided the positions of the required irregularities were known beforehand. It could, for example, rule a regular scale, and intercalate lines, at any points required.

To facilitate the use of this machine, Mr. Ackland has devised an ingenious mechanical computer; so that if it is determined to rule degrees increasing or decreasing in any known ratio, he can save the trouble of computation, and set his engine to do what is required.

It is evident that in addition to a remarkably perfect graduation of thermometers, hydrometers, etc., this machine may be employed for a variety of scientific work; and we have no doubt, as it becomes known, its ingenious inventor will have numerous applications for its use. Some alcohol thermometers graduated in this way have been highly commended by Mr. Glaisher after careful trials.

PROGRESS OF INVENTION.

Galvanic Battery with Picric Acid.—The nitrous fumes evolved when a Bunsen battery is at work, render its employment in confined situations very objectionable. If, however, a cell be filled with an aqueous solution of picric acid instead of with nitric acid, and if, instead of dilute sulphuric acid, a solution of common salt be used, a powerful action will be obtained. The addition of a few drops of sulphuric acid to the picric acid solution will greatly increase the strength of the current. This battery will be found very useful for telegraph purposes, and in all cases where the evolutions of nitrous fumes may prove objectionable.

Separation of Stearic and Margaric from Oleic Acid. — Bourgougnon has made an emulsion with fat and an aqueous solution of ammonia, by which the oleic acid is easily and completely separated, so that nothing remains but a mixture of stearic and margaric acids to be converted into soap.

Ornamental Bookbinding.—Fish-scales are largely used in the manufacture of artificial pearls. A new application of them has lately been made by Mr. A. Parkes, of Birmingham. He proposes to ornament book covers by fixing them firmly to embossed paper, linen, or other suitable material. He first embosses his material with undulations or patterns,

and then coats it with a varnish, consisting of dissolved pyroxylin, or parkesine and fish-scales. The fish-scales sink, for the most part, to the bottom of the hollows of the embossed surface, the solvent evaporates, and they become fixed, and the light playing on them produces a very pleasing effect, it being strongly reflected by the scales where it strikes at a suitable angle. The fabric or paper, after the application of the scales, can be embossed as well as before. Other materials beside parkesine may be used for the varnish, such as shellac, glue, or gelatine. Mr. Parkes also prepares a varnish with pyroxylin and aniline dye, which, when crystallized, has a metallic lustre, and this is applied to the embossed paper; here also the paper can be embossed, after the application of the varnish. In a similar manner varnish containing bronze powder can be applied to paper before or after embossing. The spreading is effected by a roller.

Purification of Paraffine.—Impure solid paraffine may be purified by first powdering it, then mixing with it common naphtha, and afterwards subjecting it to considerable pressure. By repeating this operation several times the paraffine may be almost entirely freed from the heavy hydro-carbon oils with which it is contaminated in its impure state.

Inkstands.—Improvements in Fountain Inkstands.—To prevent the ink running over the dipping-pan an independent air passage is made in the body of the inkstand, by which a constant level of the liquid is obtained, and this is produced by the action of a column of air, which causes a pressure upon the passage of the liquid, and thus prevents it from overflowing the dipping-cup. The construction is very simple: the tube is attached to the inner wall of the ink-chamber, in which a hole leading outwards is made, so as to admit the air into the tube, and through this hole, the ink can be poured to fill the inkstand. The lower end of the air passage, which is open, descends an inch or thereabouts below the level of the dipping-cup, between it and the reservoir.

Machine for Hatching Eggs.—Some years ago an incubator was made which hatched eggs by application of heat from above. This certainly seems to be the most natural way, as the heat from the hen's body strikes from above downwards. A new hatching machine has been invented and patented by T. Horrex, which acts on this principle, although in the application it is different from the method before alluded to. It consists of a flat case of metal, or other material, to hold water or any other fluid which may be thought desirable; this case rests on a frame or box, and under the lower end of the metal case, which is rounded for the purpose, a small lamp or gas-burner is placed. Mr. Horrex prefers to use a small tray of tin partly filled with oil, upon which is floated a wick; under the other or higher end of the flat case, holding the water, is placed a box or tray of a wedge-like form, for reception of the eggs. The box or tray being of this shape admits of the eggs being placed near to or at a distance from the source of heat, by simply pushing the box or tray

forward, or by withdrawing it just as one would do with an ordinary wedge, and so the heat may be regulated at pleasure. Around the top of the box tubing or list can be fastened to prevent the escape of heat. The box is partly filled with sand and such materials as will assimilate it to a hen's nest. The merit of this invention seems to consist in the easy manner of regulating the heat.

GALVANIC BATTERIES.—The object of the following invention is to make batteries more constant, to work for a longer time, to do away with the formation of dangerous fumes and polarization on the elements or in the porous cells. To accomplish this Mr. C. Bowlay makes use of the following arrangement. A porous vessel is divided by means of one or more porous partition plates, or diaphragms, into two or more separate cells, each containing its own electrolyte, or galvanic element (zinc, copper, carbon, etc.), and the exciting salt or mixture, in the dry, or slightly moistened state, and which can attract moisture from a liquid contained in an outer vessel, in which the porous cells are placed. Thus, for example, in case the porous vessel be divided into two cells, one may receive a zinc plate, or other positive element, and the other a negative element, and the cell be filled with a mixture of flowers of sulphur and chloride of sodium, whereas the other cell is to contain the negative element (copper, carbon, etc.), and be filled with a mixture of sulphate of copper, or nitrate of potash; the porous vessel is then placed in the outer vessel, and the space between them is filled with a mixture of crystals of sulphate of copper, which space may, if wished, receive in suitable opposition, a zinc and a copper plate for forming a second galvanic couple, to be used either alone, or in combination with that of the porous vessel, or be entirely left out of action. The outer vessel and the porous cells are then closed with a suitable cement, through which pass the tongues, or electrodes, for establishing metallic connection, also one or two small tubulated funnels, for allowing the proper quantity of water to be poured into the outer vessel for the solution of the sulphate of copper contained in it. The salts, or mixtures, used in the porous cells, should freely attract water, in order always to keep them in the proper moistened state required for the production of the galvanic current. For this purpose, glycerine, treacle, or other water-attracting substances, may be made use of.

LITERARY NOTICES.

A TREATISE ON ASTRONOMY. By Elias Loomis, LL.D., Professor of Natural Philosophy and Astronomy in Yale College. Author of an Introduction to Practical Astronomy, and a Series of Mathematics for Schools and Colleges. (New York: Harper Bros.; London: Trübner and Co.)—This work will be a valuable and welcome addition to our

stock of first-class educational books. Its plan is somewhat like that of the well-known "Outlines" of Sir J. Herschel, and in a series of short sections it explains the leading parts of astronomical science. It begins with the phenomena of diurnal motion, the figure and dimensions of the earth, and similar matters, which are lucidly explained with the help of judicious diagrams. In a second chapter, we find brief but comprehensive descriptions of the principal astronomical instruments. The third chapter carries us into the laws of atmospheric refraction, twilight, etc.; after which, in the fourth chapter, the "sun's apparent motion, change of seasons, different sorts of time, the calendar, and other matters come in review. Succeeding chapters deal with various astronomical phenomena, the constitution of the sun, moon, planets, etc. The explanations are very cleverly arranged, so as to require only a very small quantity of mathematics to follow them. Professor Loomis states in his preface, that his object has been to furnish "a text-book for the instruction of college classes in the first principles of astronomy;" and that he has dwelt more fully than is customary "upon various physical phenomena," such as the constitution of the sun, the condition of the moon's surface, eclipses, tides, and so forth. We think the book not only adapted to school and college classes, but to private study; and it will be found very convenient for reference, and would have been still more so if, in addition to a good "table of contents," there had been a proper index. The diagram illustrations are numerous and good, but the plates are not worthy of the work, those of the moon being especially bad. As the work is dated 1867, we think Professor Loomis might have given the recent determinations of the sun's distance, and have taken notice of Mr. Huggins's important spectroscopic researches into the constitution of nebulæ. While regretting these omissions and defects, we strongly recommend attention to the book, which will be found one of the best that has been produced.

A Manual of Inorganic Chemistry. Arranged to facilitate the Experimental Demonstration of the Facts and Principles of the Science. By Charles W. Eliot, Professor of Analytical Chemistry and Metallurgy, and Frank H. Storer, Professor of General and Industrial Chemistry in the Massachusetts Institute of Technology. Second edition, revised. (Van Voorst.)—It is unfortunate for compilers of chemical text-books that the science of which they treat is in a transition state, and the principal schools in which it is taught are not agreed upon certain important theoretical questions. In England, Professor Williamson and other great authorities have done much to promote the reception of the new views, and we may safely assume that they will prevail. They are probably more correct than the older ones, and the method of teaching founded upon them possesses a very striking superiority.

The authors of the book before us adopt a medium course; they give the atomic weights required by the followers of Gerhardt, but do not

found their course of instruction upon the principles which the new system involves. This will make their book acceptable or not, in proportion to the importance attached to the new system. They are right in pointing out that "the existence of atoms is itself an hypothesis, and not a probable one;" and in cautioning students to be cautious in accepting all doctrines founded upon such a theory, we are afraid they are also quite right in saying that "the great majority of chemists devoted to the application of chemistry in meteorology, metallurgy, dyeing, printing, and the manufacture of chemicals, remain completely indifferent to discussions of chemical theories;" but these "practical" folks, as they like to be called, are often the most impracticable—they work by rule of thumb, and have no intelligent mode of guiding themselves in new inquiries. The new system of teaching chemistry brings theory into its due prominence, and a student who goes through a good course—say at University College—will be much better fitted for the practical employment of the science than if he had been taught on the old mode.

With the exception of the chapter on Ozone, which is founded upon the theories of Schönbein that have been overthrown by experiment, we think Messrs. Eliot and Storer have produced a useful and clever work, well filled with substantial information.

NOTES AND MEMORANDA.

Scientific Soirees.—On the 15th Feb., the President of the Geological Society, Mr. Warrington Smyth, and Mrs. Warrington Smyth, gave an elegant reception at Willis's Rooms to Fellows of the Society and other scientific celebrities, with their wives and daughters. Some remarkably fine paintings of Alpine scenery and other interesting and appropriate objects were exhibited. Mr. Warrington Smyth is, we believe, the first president who has given an entertainment of this description, and it was gratifying to note, from the distinguished character of his visitors, and the universal satisfacti on expressed, how highly his hospitable efforts were appreciated. On the 17th Feb., the Old Change Microscopical Society, under the presidency of Charles Leaf, Esq., F.R.M.S., gave a highly successful soirée in two fine suites of rooms, including the great hall of the Cannon Street Railway Hotel. In addition to an important display of microscopes, some fine collections of art objects, minerals, etc., were exhibited. About 1300 visitors were present.

Mars' Rotation-Period.—The correction of Mr. Proctor's estimate of Mars' Rotation-period was not quite correctly given in the February number of The Student. Mr. Proctor's first estimate was 24h. 37m. 22·745s. (not 27·745s.); the corrected estimate is 24h. 37m. 22·73s., or 0·015s. less. Mädler's estimate was 1·07s. greater, Kaiser's 0·13s. less than Mr. Proctor's corrected estimate.

Permeability of Cast-Iron Stoves.—General Morin having requested MM. St. Claire Deville and Toost to examine the air circulating round cast-iron stoves strongly heated, they report that when the iron is at a dead or a bright red heat, the

gases of combustion are able to permeate it. They observe that the experiments of Mr. Graham has shown that a red-heat iron absorbs 4·15 times its volume of carbonic oxide when exposed to an atmosphere of that gas, and they find that carbonic oxide is absorbed by the interior surface of the stove, and given out by its exterior surface, so as to produce a sense of discomfort to those who inhale it.

Graptolites.—In "Annals Nat. Hist.," Dr. H. A. Nicholson argues in favour of placing the graptolites amongst the Hydrozoa. He considers that "they more or less resemble hydroid polyps, but are widely separated by their free hydrosoma. On the other hand, they approximate to the oceanic Hydrozoa in the fact that they were free floating organisms, and in the possession, by some forms, of an organ resembling a float."

Changes in Polar Temperature.—Professor C. Heer, in discussing the probable causes of the warmer temperature which must have formerly existed in polar regions, as indicated by the recently-discovered miocene fossil flora, is disposed to assign an important influence to the variations in the temperature of different portions of space which Poisson conjectured to exist. He conceives the sun to carry his planets through regions varying sufficiently in temperature to give rise to secular seasons of enormous length. There may be something in the idea, but we are yet without any proof that important variations in the temperature of space really exist.

Heating Power of the Moon.—The "Monthly Notices" contain a paper by Mr. J. Park Harrison, M.A., under the title of "Inductive Proof of the Moon's Insolation," in which he observes, that "the heat acquired by the moon and radiated to the earth, is entirely dark heat, and this, as Prof. Tyndall has pointed out, would be almost wholly absorbed by our atmospheric vapour. It would consequently tend to raise the temperature of the air above the clouds, and cause increased evaporation from their surface. Cloud would therefore be diminished in density, and raised to a higher elevation, and under favourable circumstances would be dispersed; in either of which events a sensible fall would necessarily be caused in the temperature of the air near the ground, owing to increased radiation of terrestrial heat to the sky. And precisely opposite results would occur at the period of minimum heat in the moon." He states that "the observations at Oxford, Berlin, and Greenwich show conclusively that the temperature of the air near the ground was very sensibly affected, the maximum mean temperature occurring on the average at each of the three stations upon the sixth and seventh day of the lunation, when the moon's crust, turned towards the earth, is coldest, and the minimum mean temperature when the same crust has been exposed for several days to intense radiation from the sun." An exception to this rule of action occurs through the formation of fresh cloud a day or two before the third quarter. When this periodic cloud is dispersed, a rapid fall in the temperature occurs. "No rise or fall of any amount occurs at new or full moon, though a tendency towards change seems clearly indicated shortly before full moon. The difference between the maximum and minimum results is 2°·3 F." Thus it seems ascertained that there is some truth in the long-cherished popular belief that the moon does exert an influence on the weather, though not to the extent supposed. There may, however, still be methods of action not yet ascertained.

VIOLET PLANTAIN-EATER.

WHITE-CRESTED TURACU.

VIOLET PLANTAIN-EATER.

WHITE-CRESTED TURACU.